

HIGH TECHNOLOGY

BUSINESS

COMPUTING
FOR CEOs

FEBRUARY 1988

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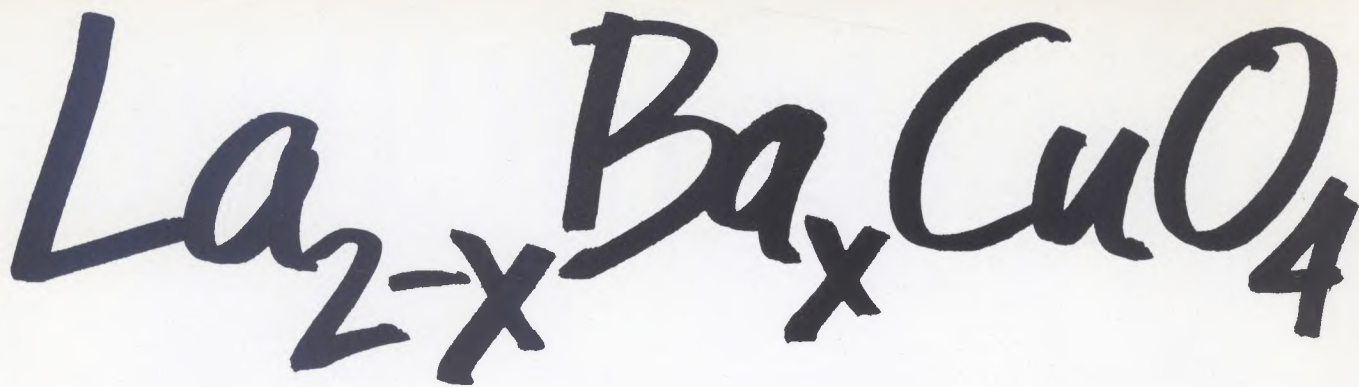
INTERACTIVE COMPACT DISCS: THE \$100-MILLION GAMBLE

Creating CD's
New Market:
Sony's Yoshio Aoki

■ Entrepreneurial Spirit
Wins Aerospace Bids

■ Biotech Invades
The Drug Counter





It started in an IBM lab in Zurich, Switzerland.
Who knows where it will stop?

In January 1986, two IBM scientists, J. Georg Bednorz and K. Alex Müller, ended a long quest. They discovered a whole new class of superconducting materials, represented by the formula above.

Their breakthrough sparked enormous activity in an area of research most scientists had abandoned as hopeless.

Today, researchers at IBM, and throughout the world, are expanding on what these two started. And although no one can be sure where superconductor research will lead, there is potential for advances in everything from computers to medicine.

In October 1987, just 21 months after their breakthrough, Bednorz and Müller were chosen to receive the Nobel Prize in Physics.

Naturally, we're proud of these two scientists, just as we are of the two IBM scientists who won the 1986 Nobel Prize in Physics.

Providing a climate that fosters achievements like these has always been important at IBM. After all, advances of this magnitude do more than contribute to a company. They contribute to the world.

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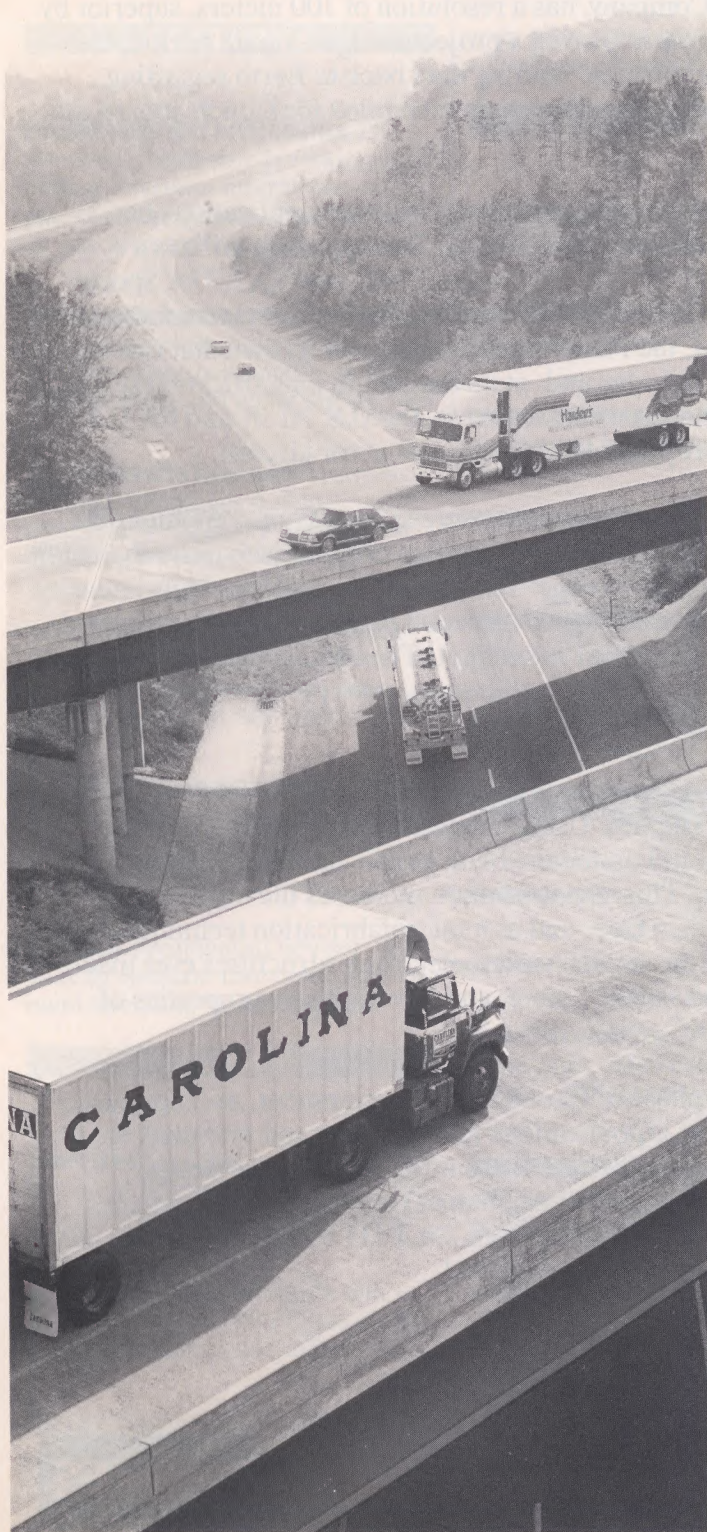
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NORTH CAROLINA
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A spacecraft to be sent to explore Earth's planetary twin will use a sophisticated sensor to beam back the first detailed map of Venus. NASA's Magellan Mission will carry a synthetic aperture radar (SAR) and an altimeter antenna to peer below Venus' dense, noxious carbon dioxide/sulfuric acid atmosphere. The sensor, built by Hughes Aircraft Company, has a resolution of 100 meters, superior by a factor of 10 over the resolution of current surface data. During a projected eight-month period, the spacecraft will map over 90 percent of the Venusian surface, sending data back to Earth regarding geological processes that formed the planet. The Magellan Mission is scheduled for launch aboard the Space Shuttle in April 1989.

A system for night reconnaissance, border surveillance, and specialized military applications has recently completed 150 successful cross-country demonstration flights. The approach utilizes a Hughes Night Vision System (HNVS) aboard Schweizer Aircraft Corporation's new SA 2-37A Special Purpose Aircraft. The HNVS is a forward-looking infrared (FLIR) system that lets crew members see at night and in poor visibility conditions. Unlike radar, the FLIR emits no energy of its own that can be detected during operations. It can locate and track vehicles and, at its maximum magnification setting, can even delineate individual tree limbs and branches. HNVS is in use by the U.S. Army and the U.S. Customs Service, and was selected for use on the proposed V-22 Osprey tilt-rotor aircraft.

A new graphics projector offers improved performance for the large-screen display of computer data. Designed and built by Hughes, the Model 800 graphics projector increases brightness to more than 600 lumens and improves resolution to over 1,000 lines edge to edge. The projector combines high-intensity illumination with Hughes' liquid crystal light valve technology to generate bright, real-time projected displays of both graphic and alphanumeric images in normal room light. The Model 800 is designed for applications including computer-assisted training, design conferences, sales presentations, teleconferencing, and classroom and lecture hall use.

The highest resolution ever obtained for scanning ion microscopy, representing a two-fold reduction in probe size, has been demonstrated by Hughes. Using a focused ion beam microprobe, features as small as 15 nanometers—approximately 100 diameters of an atom—have been clearly resolved in images of nickel crystals in a wire mesh. This size resolution increases the utility of this technology for high-resolution chemical analysis of surfaces and as a microfabrication technique. Such ultra-high resolution may permit the fabrication of the smallest microelectronic structures ever made—structures in which electron movement is confined as never before, and in which new properties of quantum physics take effect.

Hughes Missile Systems Group is advancing every phase of research and development, as it applies to tactical guided missile systems and strategic defense. Opportunities for engineers and scientists are in analog/digital circuit design; high-voltage power supply design; transmitter and radome design; electro-optical design; IR imaging sensors; focal plane arrays; mechanical engineering and systems engineering. Send resume to Hughes Engineering Employment, Dept. S4, 8433 Fallbrook Ave., Canoga Park, CA 91304. Equal opportunity employer. U.S. citizenship required.

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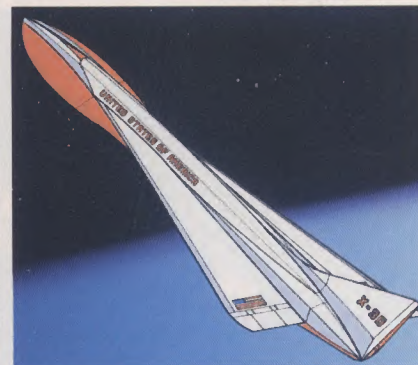
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Computers become executive tools, p. 41.

Cover photography by E.J. Camp

Back By Popular Demand.

At one time, peregrine falcons nested by the thousands throughout the United States. But with the widespread use of the insecticide DDT in the 1940s and 1950s, the species suffered greatly. In the eastern U.S., the peregrine falcon disappeared entirely.

Now peregrine falcons have made a comeback, thanks to efforts by conservationists.

Since 1975 when recovery programs were established, 752 peregrines have been released in the eastern U.S., and there has been a steady increase in the nesting population.

With wise conservation policies, other once rare species such as the American alligator and the bald eagle have also made comebacks.

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A \$100-Million Gamble

TECHNOLOGICAL BREAKTHROUGHS sometimes don't succeed commercially, even if the market is waiting. What, then, are the chances of a technology for which not only products but demand must be created?

That was what we wanted to find out about interactive compact discs, which may appear on the market as early as this fall. Companies developing compact disc-interactive, or CD-I, say the systems will let people entertain themselves with more dynamic and lifelike video games, or educate themselves with sight-and-sound encyclopedias.

The question is, will they want to? Philips, Matsushita, and Sony are staking millions of dollars on the answer. Assistant managing editor Jeffrey Zygmunt, who researched and wrote the CD-I story that begins on page 18, spoke with industry observers who say that because CD-I is such a dramatically different combination of technologies, companies may have to wait out years of consumer resistance.

Zygmunt also found that the CD-I concept is so unprecedented that even analysts familiar with the industry are hard-pressed to predict whether the gamble will succeed with consumers, even though growing numbers in the business world already use similar technology for training and marketing (see "CD-I In Business," page 23).

The decision by the big electronics manufacturers to focus major marketing efforts on consumers also promises to open a vast market for smaller companies that are preparing CD-I programming such as games, video books, and music videos. Our story outlines the strategic positions of the major players and how prepared they are to roll the dice on CD-I.

This issue also features a story on executive information systems, which give corporate leaders strong incentive to use computers themselves instead of relying on subordinates for information (see "Computers Invade the Executive Suite," page 41). These systems let executives monitor company performance. We talked to people about how they use the systems to make their companies more productive.

We'd also like to call your attention to improvements in the High Technology Business Leading 100. Each month, this section tracks the high-technology stocks with the biggest percentage gains. Beginning this month, we will list the exchange on which each stock is traded as well as its symbol. And to give you a better idea of each stock's performance, we now tell you where it placed within its industry.

It's all part of continuing to give you the knowledge you need about technology and its business implications.

Charles L. Martin Jr.

Charles L. Martin Jr.



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For more information and price quotes, contact Jennifer Batikha, Syndicate Sales Manager, at HIGH TECHNOLOGY BUSINESS, 214 Lewis Wharf, Boston, MA 02110, (617) 723-6611.

■ Translation Opportunities

EVERY MUCH enjoyed Robert Wood's column on Japan's machine translators in your November issue. As a language management company, a major part of our work is to develop international marketing, training, and regulatory materials for high-technology firms.

Most high-tech companies do not realize that, as they develop a new technology, they also develop a new language. The problem is compounded when they have to translate the new technical terms into six or seven languages. In many cases, technical translations represent the first time these words have been put together in a foreign language, and as such, they represent a trademark opportunity.

Many companies do not give the necessary care to developing a glossary. This is particularly true of small and medium-size companies. A typical attitude is, "George's sister can translate this for us cheaper than a professional can." By taking this approach, companies not only miss trademark opportunities but cause a lot of confusion when they keep changing definitions as they change translators. Also, liability problems can occur due to poor translations.

As a final comment, I congratulate your art director for the layout of your magazine. Who said high tech had to be boring?

*John Freivalds
Euramerica*

Minneapolis, Minnesota

■ Pleasantly Surprised

IN MY SEVERAL years of managing a small company involved in the design and manufacture of industrial mobile robots, I have developed a painful Pavlovian response to articles in business publications about new technologies. Early in the technology life cycle, the articles tend to be full of exponential growth curves from market studies, mixed with the arm-waving of entrepreneurs trying to hype stock. All of this is described as seen through the eyes of a writer with no technical training. The result is to encourage over-investment in the technology and wasteful competi-

tion. When the U.S. competitors have worn each other down scraping over the lean early market, the Japanese step in with a polished second-generation product and take the market away.

As the shakeout begins, the articles change to a search for the guilty. These criticisms are generally as distorted as the earlier advice, and seldom leave one with a true picture of what happened. The final advice is generally to "cut your losses and run."

It was therefore with some skepticism that I purchased my first copy of HIGH TECHNOLOGY BUSINESS, the October 1987 issue, and began to read Herb Brody's article, "U.S. Robot Makers Try to Bounce Back." I was very pleasantly surprised. The analysis of what happened in the industrial-robot-arm market was well researched and coherent. Mr. Brody's treatment of new applications for mobile robots in the service sector was of even more interest to me, since that is our company's marketplace.

The lesson Mr. Brody offers bears emphasis. New technologies bring new opportunities, but they also bring new and often unexpected challenges. Companies and investors entering these fields must understand that there will always be surprises and setbacks.

Mobile-robot technology is now adequate for performing real work in many structured environments, but we are a long way from R2D2, the robot in the *Star Wars* films. I pray that we will not have to repeat the history of the robot-arm industry. With more articles like Mr. Brody's, we may not.

*John M. Holland, President
Cybermation Inc.
Roanoke, Virginia*

■ We Stand Corrected

THE ARTICLE on communications satellites, "Big Hopes for Small Dishes" (November, p. 41), was incorrect on several points.

First, the statement that full-size systems use the C-band and VSATs use the Ku-band is not correct. The first VSATs built, both receive-only and interactive, used C-band and continue to do so. Al-

though it is true in theory that Ku-band antennas can be smaller than C-band antennas, considerations such as attenuation due to weather change the equation. Whereas Equatorial's C-band VSATs use a 1.2-meter antenna throughout the 48 states, current Ku-band networks predominantly use 1.8-meter antennas. None of the Ku-band products uses an antenna smaller than 1.2 meters, and some require a 2.4-meter antenna in Florida.

Second, Equatorial operates the largest network of VSATs in the world. Most of the 4,300 VSATs shipped are operated from our shared hub in Mountain View, Calif. The reference to K Mart having "the biggest network" loses meaning when we see Farmers Insurance Group with an existing network of 2,500 units and growing. All these units operate in C-band and are managed by Equatorial, which is clearly a service provider, not just an earth-station maker as stated in the article.

Also, a fully equipped, two-way VSAT can be purchased for less than \$8,000 installed, not \$10,000.

*Joseph Rinde
Director, Product Planning
Equatorial Communications Co.
Mountain View, California*

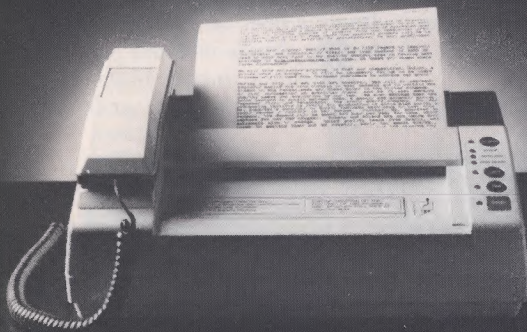
RE: "MONEY MACHINES Outgrow Banking" in the October 1987 issue:

Your list of the top five national networks on page 36 did not include Gascard Club Inc., a large reseller of Diebold terminals and automatic teller machines. Gascard operates the only truly nationwide network of unattended fueling machines—1,300 sites in 43 states. Our present volume of over 400,000 transactions per month places us third behind Plus Systems and Cirrus as nationwide networks.

*Thomas M. Cannon
President and CEO
Gascard Club Inc.
La Jolla, California*

We welcome comments from our readers. Address letters to Editor, HIGH TECHNOLOGY BUSINESS, 214 Lewis Wharf, Boston, MA 02110. We reserve the right to edit letters for length and clarity.

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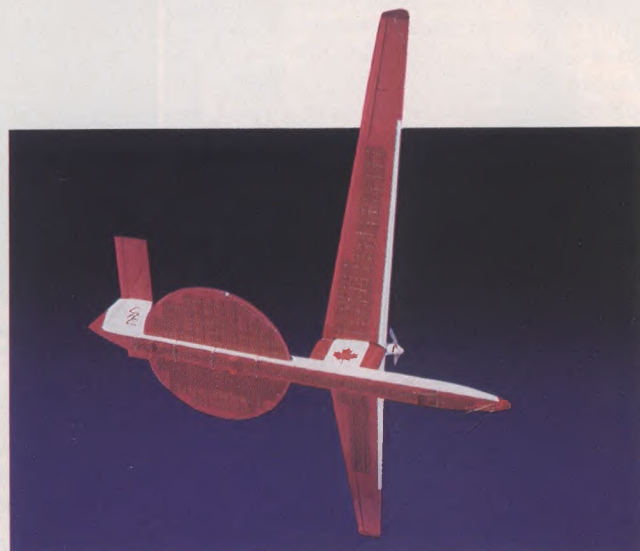
This Plane Runs On Microwaves

THE SAME microwaves that defrost a dinner can fly an airplane, and microwave-powered planes may someday replace satellites in many methods of communication.

Late last year, the University of Toronto's Institute for Aerospace Studies, working with the Communications Research Centre of the Canadian Department of Communications, launched the world's first microwave-powered airplane. After taking off on battery power, the bright red plane flew for 20 minutes by remote control, drawing its energy from a 10,000-watt microwave beam transmitted from the ground. The one-eighth-scale prototype weighed 10 pounds and had a 13-foot wingspan. After flying at 300 feet, the craft returned to battery power for a safe landing.

The plane is part of the Stationary Height-Altitude Relay Platform (SHARP) program, which aims to develop microwave planes with 120-foot wingspans. Such planes would transmit radio and television programs, relay messages for regular or cellular telephones, and monitor traffic and weather. Police and foresters could use the plane to watch for forest fires, farmers could inspect crops, and coast guards could track icebergs.

Flying more than 13 miles



Microwaves power a 10-pound prototype airplane in Canada.

above the ground, such a plane could serve an area almost 400 miles in diameter at a price satellites can't match. Because the plane's electronics would also be powered by microwaves beamed from the ground, it could transmit more powerful signals than satellites can, allowing earth stations to use smaller receiving antennas. Unlike satellites, the planes could easi-

ly be relocated as needed, and merely land for servicing. The program envisions planes that stay up for months, powered by a dozen transmitters.

The next step is to test a larger prototype flying two to three miles high. The initial prototype cost about \$1.5 million, and the program will need more than \$6 million for the next phase.

Test Analyzes Hair To Detect Drug Use

MOST DRUG tests reveal only if a substance has been used a few days before the exam. But a system under development by Psychomedics of Santa Clara, Calif., analyzes hair to determine whether a person has used drugs during the past several weeks, months, or even years.

The test detects drugs

such as cocaine, marijuana, PCP, and heroin, which leave the bloodstream quickly but deposit telltale by-products in a person's hair that remain indefinitely. Hair testing can reveal even modest use, such as a weekly diet of one line of cocaine or two marijuana cigarettes, according to Charles Black, Psychomedics' vice president for medical affairs.

The key to the system is a proprietary technique that extracts drug-derived chemi-

- Shoppers use video to buy shoes at Florsheim
- Companies combine high-tech mail services
- 3-D sound begins to look for commercial uses

cals from a sample of hair. A few strands will do, but a shock of 60 or more assures maximum sensitivity. The hair is chopped into segments that correspond to periods of time; hair grows about half an inch a month, so shoulder-length strands might betray a history of drug consumption over the past two years.

Psychomedics then adds monoclonal antibodies, compounds that attach to specific chemicals. The antibodies are tagged with radioactive atoms; the intensity of the sample's radiation indicates the quantity of drugs taken while the hair was growing.

The company is pursuing two main markets, says president Karel J. Samson. Insurance companies are interested because hair analysis would give hospitals a record of drug use to provide more effective treatment.

Samson also expects demand from employers who want to test workers in sensitive jobs. One worker reportedly got his job back after hair analysis confirmed that a

previous urine test had given a false positive result.

Psychomedics netted \$2.8 million in an initial public offering last year, and Samson believes revenues from the hair test will bring a positive cash flow this year.

Small Scanners for Small Publishers

SMALLER, less expensive hand-held optical scanners will let desktop publishers incorporate a wider variety of source materials in their publications.

To scan line art and photographs, publishers with IBM PCs or compatible computers can use the Handy Scanner-1000 from Diamond Flower Electric Instruments of Taiwan and Sacramento, Calif. The \$299 device scans a 3½-inch wide swath and delivers the image to desktop-publishing programs such as Dr. Halo II, PageMaker, Ventura Publishing, and Gem. The scanner also works in such software environments as Microsoft Win-



Desktop publishers find new uses for hand-held optical scanners.

BILL SANTOS

dows. Built by Matsumi in Japan, the device has a resolution of 200 dots per inch.

Diamond Flower Electric is working with Electronic Information Technology of Fairfield, N.J., to create software that would equip the scanner to read printed text. This enhancement should be out this year.

Another hand-held scan-

ner, the Handscan from Saba Technologies of Beaverton, Wash., claims to deliver letters and numbers to a computer two to three times faster than can keyboards. The \$650 device reads a variety of typefaces. Saba says its product is made to scan data for spreadsheets, but could be used for word processing.

A Closer Look At Heart Damage

A NEW X-RAY camera will give doctors a better look at diseased hearts and blocked arteries. The Multiwire Gamma Camera assesses heart damage more quickly and cheaply than an arteriogram, and exposes patients to less radiation.

Xenos Medical Systems Inc., a subsidiary of Baylor College of Medicine in Houston, is preparing to market the portable camera, which emits one million X rays per second to track a radioactive agent's journey through a patient's heart. The camera's developer, Jeffrey Lacy, says the device works six

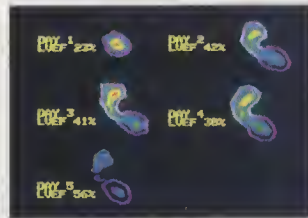


Multiwire Gamma Camera gives doctors a better view of the heart.

times faster than conventional cameras, which emit 150,000 X rays per second.

"This camera detects even very small areas of the heart that are not receiving enough oxygen because of reduced blood flow," says Lacy.

In addition, the test exposes patients to just one-thirtieth of the radiation they receive with current



techniques, and hundreds of times less radiation than an arteriogram, according to Lacy. The camera uses a radioisotope called tantalum 178, which has a half life of only 9.3 minutes, compared with half lives of six hours or more for other isotopes used in medical procedures. This dramatically reduces the body's exposure to radiation without impairing the cam-

era's view of the heart.

"The lower radiation makes the camera especially beneficial for use with children," says Xenos president Ron Spain. Doctors rarely use imaging procedures on children because youngsters are especially sensitive to the effects of radiation. Spain estimates that 30,000 infants born each year with heart defects could benefit from the new procedure.

In addition to obtaining better pictures more safely, the camera is also cheaper to use than current imaging techniques. Lacy says a typical Gamma Camera test will cost about \$650, about one-quarter the price of a typical arteriogram.

THE METHODIST HOSPITAL, BAYLOR COLLEGE OF MEDICINE

EDELMAN PUBLIC RELATIONS



Shoe shoppers use video technology to expand their choices.

If The Shoe Fits...

ADVANCED video technology has invaded the shoe store.

By late last year, Chicago-based Florsheim Shoes had installed nearly 350 "electronic sales assistants" in its 5,000 shops across the country. The company hopes to double that number this year on the way to creating a national network of 2,000 video merchandising centers.

The "assistants" are interactive video terminals that use video disks housed in small kiosks. The video centers let customers view and buy shoes that may not be available in every store. Developed by Byvideo Inc. of Sunnyvale, Calif., the terminals are "the world's smallest shoe store with the world's largest selection of shoes," claims Harry Bock, Florsheim's vice president of marketing services.

Bock says Florsheim carries about 428 styles. If a store doesn't have a particular shoe in stock, a customer can see audio/video presentations of different shoe collections merely by touching the computer screen. After the customer makes a selection, a purchase order is electronically transmitted to the company's warehouse, which

mails the shoes to the customer within seven days.

Conrad Jutson, Byvideo's senior vice president of sales and marketing, says demand for the terminals is growing. Zale jewelers has installed 50 information terminals, and both Lowes home-improvement centers and clothing manufacturer Levi Strauss are using similar systems.

Please Don't Touch the Screen

POINTING IS proper with the Contaq PointScreen. Unlike traditional touchscreens, the PointScreen uses ultrasonic sensors mounted on the monitor frame to respond to a pointed finger that does not touch the screen.

The screen detects objects as small as a finger in hundreds of positions, but will ignore a waved hand or clenched fist. Because no physical contact is involved, the device protects the monitor from dirt, scratches, and deterioration. It also eliminates the need for a screen overlay, ensuring an unobstructed view.

The \$695 PointScreen adapts to monitors with screens 9 to 26 inches across. The system connects to the computer through a serial

Signs of a Smart Card Invasion

COMPANIES around the world are developing new uses for "smart" cards. The size and shape of a credit card, these devices pack microchips with enough power to let users do far more than pick up the check at lunch.

A number of experiments using the cards are underway around the world (see "Smart Cards Get Smarter," September 1987), and two major projects involving smart cards have been announced recently in the United States and Japan.

In the United States, smart cards are going to school. Smart Card International has signed a contract with Robert Morris College in Chicago to develop a so-called unified card to handle such tasks as course registration, faculty scheduling

and planning, and library services. The card could also carry information on subjects such as tuition and health records. The project should enter commercial service this year.

In Japan, Toshiba, Nippon Telegraph & Telephone (the Japanese phone company), and Visa International plan to test 2,000 cards this fall. The Japanese card, built by Toshiba, has a keyboard, display, and memory. Volume production is planned for the end of the decade.

To use the card for retail purchases, customers enter the transaction amount and an authorization code; the system deducts the purchase price and the card records the user's new balance. In addition, Nippon Telegraph & Telephone plans to install public telephones that use the card for automatic dialing.

port and includes an interface card and software. Replaceable controller cards for on-the-spot repairs are available from Contaq Technologies for about \$50.

Contaq, based in Bristol, Vt., derived the PointScreen from its ultrasonic distance-measurement board, which is used mostly in manufacturing and security systems.

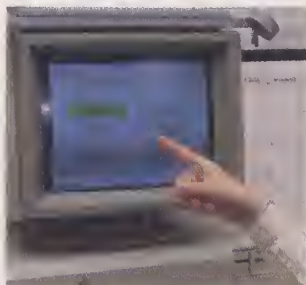
The company will sell directly to consumers, but mainly wants to market the PointScreen to equipment manufacturers, resellers,

and dealers. Possible uses include industrial process control, public information retrieval, kiosk information centers, and interactive displays. Contaq hopes to sell more than 3,000 of the patented devices this year.

Voice Mail Meets Electronic Mail

AS BOTH voice mail and electronic mail increase in popularity, a growing number of visionary companies are looking at integrating the two into a powerful communications tool accessible from both computers and telephones.

More than a dozen companies—including Wang Laboratories, AT&T, IBM's Rolm, Applied Data Research, Zymacom, and American TeleSystems—are trying to integrate text and voice mail.



PointScreen: close is good enough.

CONTAQ TECHNOLOGIES

According to Blair Pleasant, a market researcher at the Yankee Group, computer companies such as IBM, Digital Equipment, and Wang will lead the way. "They have the investment in electronic mail, and I think they are in a better position [than are smaller companies]," Pleasant says.

Both Digital Equipment and Dallas-based VMX have implemented integration schemes with All-in-1's electronic mail service, and Rolm has a phone-mail system that communicates with IBM-mainframe text mail to tell users messages are waiting. Eastman Kodak is trying to unite a VMX voice-mail system with an IBM Profs com-

munication network.

But telling users that a message is waiting is only the first step in integrating the two formats. The goal is to create an integrated mailbox, where users can log on to one service for both voice and electronic mail.

Holophonics: 3-D Sound

A NEW PROCESS called holophonics does for sound recording what laser holograms do for pictures.

Developed by Hugo Zuccarelli of Argentina, holophonics takes advantage of a 1983 discovery at the St. Louis Central Institute of the

Deaf that the human ear produces, as well as receives, sound. Just as holograms create three-dimensional images by setting up an interference pattern between laser light sources, the mostly inaudible sounds produced by the ear set up an interference pattern that helps the brain construct a more three-dimensional sound image to locate sound sources. The system goes beyond stereo to distinguish the vertical position of sound sources and find sounds coming from behind the listener.

The process uses a pickup device shaped like a human head, which emits sounds that mimic those produced by the human ear. A series of

interferometers inside the device transform the interference patterns into sounds the brain can understand.

Zuccarelli has been cautious about licensing the new process, but is forming a company to market holophonics to the entertainment industry. He is also working to sell the technology to aircraft manufacturers for flight simulators, and hopes to use it in hearing aids and video games.

Rainbow Harvest Productions of Fairfield, Iowa, has used holophonics to produce an educational tape for children. The company has also established a research institute to study potential medical uses for holophonics.

ALSO WORTH NOTING



Better pacemakers allow exercise.

■ New advances in pacemakers let their wearers lead more normal lives that include exercise. Until recently, the 110,000 pacemakers implanted each year in the United States were set at a constant rate, and often caused dizziness or fatigue if the wearer's actions required a faster heartbeat. But pacemaker wearers, whose normal heart rates have been disrupted by disease or a heart attack, got a boost in 1986 when Medtronic Inc.

of Fridley, Minn., introduced its Activitrac. This pacemaker used a body-motion sensor to pick the appropriate tempo. Siemens Medical Systems Inc. of Iselin, N.J., expects the Food & Drug Administration to approve its Senso-log, a similar device, later this year. Also hoping for approval are two other companies that make products that vary heart rate in accordance with metabolic changes. The Nova MR—from Intermedics in Angleton, Tex.—measures blood temperature; the Meta MV—from Teletronics in Englewood, Colo.—tracks respiration rate and volume. All the new pacemakers will sell for about \$5,000 each, only a few hundred dollars more than current models.

■ Anyone who travels but needs to stay connected to a database should watch for the first cellular laptop modem, due out early this

year. The modem, developed by OmniTel Inc. of Fremont, Calif., and Spectrum Cellular of Dallas, transmits data at 2,400 bits per second—fast enough to send a typical page of text in less than 10 seconds. The device works wherever a cellular phone works, according to its makers. To help keep the price down, OmniTel bought the product's microprocessor off the shelf and added its own programming.

■ By adapting technology developed to record music, electronics companies may soon let personal-computer users store a gigabyte of data—more than 1,000 times the random-access memory in most of today's personal computers—in the space of a 5¼- or 3½-inch disk drive. Hitachi Ltd.'s New Electronic Media Division plans to use large-scale-integration microchips to shrink its prototype Digital Audio Tape-

Mass Storage System (see "New Uses For Digital Tape," October 1987) from a standalone device about the size of a briefcase to fit in the disk-drive slot. The standalone system should appear on the market this summer.

■ Super Slurper, an ultra-absorbent material developed by scientists in 1976, is finding new uses in agriculture. The compound, which absorbs about 1,000 times its weight in any number of liquids, is made of starch and Orlon. Farmers are coating seeds with Super Slurper to increase water retention during germination, and adding it to sandy soils to keep water near a plant's roots. It also helps keep worms moist so they can stay alive to eat pests living in the soil. In addition, the compound has found its way into disposable diapers, body powders, sanitary napkins, and fuel filters.



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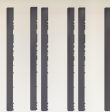
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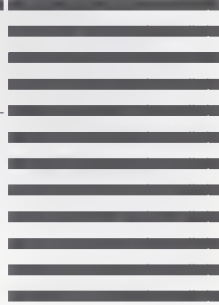
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Laptops' Portable Power

EXPENSIVE 'TOYS' EMERGE AS FUNCTIONAL TOOLS

■ By Andrew M. Seybold

LIGHTWEIGHT, battery-operated personal computers designed for use anytime and anywhere—in the office or on an airplane—have been on the market since 1984. But until recently, these “laptop” computers have been perceived by most business people as expensive toys.

And with good reason. The early laptops, with their barely readable screens, less-than-adequate storage capacity, and short battery life, were far from the kind of functional, reliable tools business people had a right to expect. To make matters worse, laptop computers were expensive, costing anywhere from \$3,000 to \$5,000. As a result, laptops were bought primarily by companies and individuals with a compelling need for portability, such as auditors and salespeople.

In the past year, the general perception of laptops has begun to change, for several reasons. The strongest reason is the availability of better products. Several companies that sell laptops, including Epson, Tandy, Toshiba, NEC, and Sharp, have done an excellent job of combining the technological advances developed during the last three years with manufacturing economies to produce better, more affordable products that meet the needs of a broader class of users than earlier offerings did.

In short, today's laptop computers are faster, cheaper, and more reliable than ever before. Many laptops on the market, including those from Zenith, Data General, and Epson, now have more readable backlit screens. Also, most incorporate longer-lasting, more reliable batteries and fast hard disks that can store and retrieve large amounts of information.

The first truly MS-DOS-compatible

laptop was offered by Data General more than three years ago. It provided 256 kilobytes of memory and cost \$3,500. Data General's current unit, the \$1,995 DG1/2 with 640 kilobytes of random-access memory and a hard disk, is as powerful and functional as many desktop computers.

Prices for today's laptop computers start at less than \$1,500 and run to well

over \$3,000. On the low end of the price scale is Radio Shack's new DOS-compatible unit, the 1400LT. On the high end are the laptops produced by Grid Computers, considered the Cadillacs of the industry. Other companies with significant products in this market include Toshiba, with models to meet almost every need; Zenith, whose machines were among the first with backlit screens for better readability; NEC, whose several laptops offer built-in software; Sharp, whose many options include a hard disk; and Epson, with a unit that provides a choice of detachable screens.

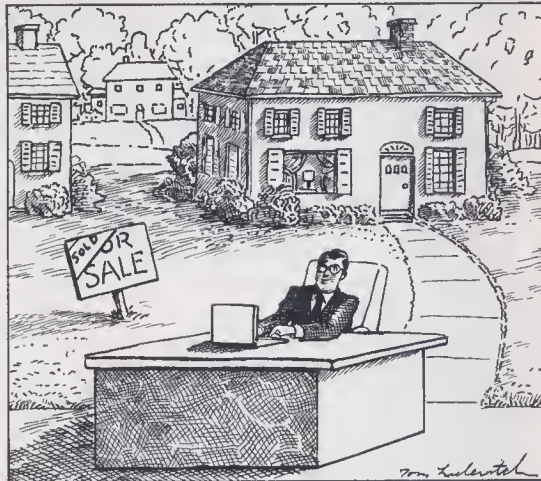
The other major reason for the improved perception of laptop computers is a greater emphasis in businesses of all kinds on the importance of having information at one's fingertips. Being able to exchange data with a host computer from a hotel room, to receive elec-

tronic mail while “in the field,” and to take one's office on the road (including all supporting documents and files) has become extremely important. Corporations increasingly see the need for better and more flexible information management. It's no longer sufficient to have information available only at the office during normal working hours. As a result, high-performance laptop computers are rapidly making the transition from adult toy to useful, often indispensable business tool.

As technology continues to advance and more desks have computers on them, more busy executives will find laptops to be time- and labor-saving devices they cannot do without. Increased competition in the laptop market will probably have some very positive consequences for business users. It should keep sellers on their toes by providing incentive to continually upgrade and improve their products, to incorporate such enhancements as more powerful processors and more readable screens (which eventually will be color), and to keep pace with advances in technology as they occur.

In addition, increased competition may encourage more discussion between manufacturers and potential laptop-computer users. As the laptop market heats up, companies that want to remain competitive will have to distinguish their offerings from those of everyone else. That will involve listening to potential users to find out what kinds of business tools they need, and the price they are willing to pay. Companies that do the best job of creating such products will enjoy the most success in this emerging market. ■

Andrew M. Seybold is editor-in-chief of Andrew Seybold's Outlook on Professional Computing, a California-based newsletter.



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Photos Go Electronic

NEW STANDARD PULLS IMAGES INTO COMPUTER AGE

■ By Robert Chapman Wood

THE TRADITIONAL photograph just doesn't fit in today's high-technology workplace. Automated offices handle text with ease, but photographs remain hard to print, complex to manipulate, expensive to process, and difficult to transmit over telephone lines.

The Japanese-led Electronic Still Camera Conference has devised a new set of specifications that promise to standardize products that create stop-action video pictures much like ordinary photographs. These electronic images, however, will be much easier to use in business because they can be stored and manipulated by computer.

The first business products are already available—Sony says it has sold more than 5,500 units of its Mavica imaging system in the United States. Other still-imaging products could begin to penetrate the consumer market as early as this year.

A group of Japanese companies, initially led by Sony, has been working on electronic still-image cameras and recorders since the 1970s. Last year, with the participation of Sumitomo 3M and such U.S. companies as Kodak and Polaroid, the 43-company conference established specifications for a new generation of electronic imaging systems that use special microchips called charge-coupled devices to record the images in an analog format, patterned after videotape.

Such systems store 25 images on a two-inch floppy disk. If users are willing to settle for half the clarity, they can squeeze 50 images onto a disk.

Unfortunately, even the sharper images, which offer the 483-line resolution of a television picture, cannot compare with the quality of a typical 35-mm photograph. In a few years, the advent of

high-definition television may correct this imbalance, but meanwhile, supporters say, electronic imaging's flexibility should help compensate for its lack of definition. They say the current level of resolution is good enough for use by daily newspapers and even by weekly news magazines.

The heart of a still-image system is the deck that holds the disks—equiva-

ing decks can grab images from any available video source—video cameras, video recorders, or directly from broadcast television.

Sony, Matsushita/Panasonic, Minolta, Fuji, Konica, and Casio introduced still-imaging products in Japan a few years ago, and Sony, Canon, and Kodak followed in the U.S. market last year. Most manufacturers aimed primarily at

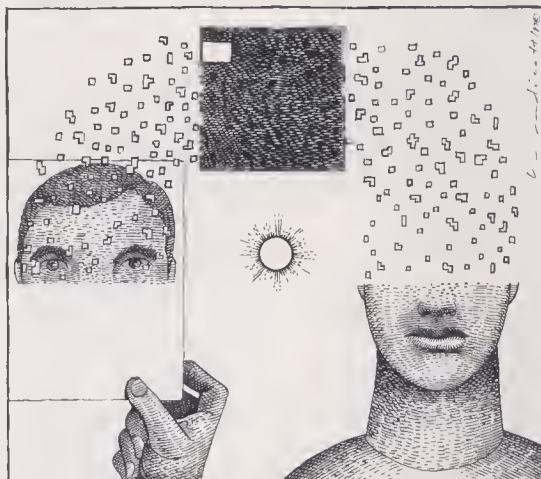
broadcasters, publishers, and computer-graphics users. But proponents predict large corporations that regularly send images from one office to another represent an even larger market.

Eventually, the technology is expected to fulfill its potential in the consumer market. Andrew Wilson, editor of the trade magazine *ESD*, predicts that if high-definition television can sufficiently improve picture quality, still-video imaging could capture at least 60 percent of the worldwide photography market.

But most traditional camera companies are afraid of cannibalizing their sales of film cameras. So far, Casio's \$800 still-imaging camera is the only product aimed mainly at consumers, and is available only in Japan. Other companies are waiting for prices to fall from today's \$3,000 to \$4,000 for a deck and \$10 per disk.

Some companies aren't willing to wait much longer. Kent Ekberg, project manager for still-image systems at Sony America, expects several leading manufacturers, perhaps including Sony, to introduce home systems by the end of this year. Even though consumers will be able to view their photos immediately on television screens, they will probably have to take their disks to the local photo store for printing. ■

Robert Chapman Wood is a writer and business consultant who specializes in the economies of the Orient.



lent to a home tape deck or VCR—but users can add peripheral devices for new functions. Sony's Mavica system, for example, lets users rearrange images on disks and copy them from one disk to another, transmit images over telephone lines, store as many as 8,000 digitized photographs on a 16-gigabyte optical disk, make instant four-color separations for printing presses, and print glossy images.

Several manufacturers, including Sony, have introduced cameras that make pictures directly on floppy disks. Other camera companies, such as Minolta, offer special backs that attach to their conventional cameras, replacing the film with a charge-coupled device and a floppy disk.

However, one of the beauties of the standardized format is that users don't really need a special camera. Still-imag-

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Investors Gain Clout

RULES GIVE VENTURE CAPITAL GREATER CONTROL

■ By Andrew Updegrove

STRONG-WILLED but cash-poor entrepreneurs have always complained about the advantage that financial leverage gives their venture-capital investors. Business people will probably feel that influence even more strongly as a result of recent Department of Labor regulations that supervise the investment of pension-plan funds.

The regulations, which took effect March 13, 1987, cover investments by most venture-capital funds formed after that date in which more than 25 percent of the investment money comes from pension plans. At the moment, that translates into a relatively small number of funds. However, the money in pension plans represents the largest single pool available to venture capitalists. As venture-capital firms continue to be formed, the rules that govern that pool will become increasingly important to startup companies, which are a crucial aspect of high technology.

The new rules treat investments made by such funds as regulated "plan assets" under the Employee Retirement Income Security Act of 1974. That means new funds will be subjected to fiduciary and other duties that would seriously impair their normal operations. For many funds, the only practical alternative to meeting these burdensome restrictions will be to qualify as a venture-capital operating company (VCOC).

To do so, a fund must have at least half its assets in operating companies that grant certain management rights to the venture-capital investor. The fund must also actually exercise such management rights over at least one portfolio company annually.

Although the regulations left the definition of management rights deliberately vague, they state that such rights

must enable a venture-capital operating company to "substantially participate in, or substantially influence the conduct of, the management of the operating company."

What does this mean to the entrepreneur? Although the new regulations will not necessarily diminish the flow of pension-plan money into venture-capital funds, they will have an increasing

deadline was well publicized and many funds raced to be "grandfathered" under the old rules. As new funds form, however, pension-fund managers will require them to agree that they will meet the VCOC exemption when making portfolio investments.

The effect of the new regulations on venture capitalists' activities will be mixed. For active funds that already demand seats on the boards of portfolio companies, the impact will be effectively nil. But for those very large funds that tend to be passive investors and participate only in later-round financings, the effect will be more problematic. Such funds will have to become more involved in the affairs of portfolio companies than they currently choose to be.

The interesting question will be whether any new terms that are developed to take advantage of the VCOC exemption take on a life of their own; many venture capitalists may decide to use them whether or not the investor actual-

ly needs the exemption.

The leverage issue is complicated by the recent drop in technology-company valuations and the need for venture-capital investors to maintain greater reserves. Investors will need to put more money into existing portfolio companies that, prior to October's market crash, had anticipated going public in the near future. Given all three factors, startup companies will find their bargaining position with potential investors increasingly weak. Greater investor influence over their destiny, and perhaps their daily activities, will increasingly become a topic of tough negotiation. ■

Andrew Updegrove, a partner in the Boston law firm of Lucash, Gesmer, and Updegrove, represents high-technology companies and venture capitalists.



effect on how venture-capital transactions are structured.

The legal community is still trying to guess what contract terms might reliably satisfy VCOC requirements. However, the management rights that venture-capital companies might demand include:

- the right to appoint a director to the portfolio company's board.
- the right to discuss the affairs of the portfolio company with its officers and advise them on how to manage their business.
- the right to inspect the portfolio company's facilities, books, and records.

Such rights, the regulations make clear, cannot be delegated to an investor group representative, as is usually the case.

The impact of these rules has not been pronounced to date; last year's

Compact-Disc Companies Test New Frontier

*Electronics companies are about to bet millions
that consumers want to talk to their TVs*

BY JEFFREY ZYGMONT

RECENT success stories in consumer electronics have been replacements for or adaptations of existing products. Audio compact discs are an improvement over vinyl records. The Walkman craze married transistor radios and tape recorders. Video cassette recorders rode piggyback on America's love affair with television.

But something original is about to step forward. Flush with the success of audio compact discs, consumer electronics companies are poised to stake millions on a technology that combines high-fidelity sound, television pictures, and computer power—interactive compact discs. Compact disc-interactive, or CD-I, is the home-electronics industry's most radical new technology in quite some time.

"Nothing like this has ever been attempted before," says Marc Finer, a former Sony executive who is now mar-

keting director for consulting firm Communication Research.

CD-I developers want consumers to spend hundreds and even thousands of dollars on something they didn't know they needed or even wanted. As the name implies, interactive compact discs require people to get involved with a program. Personal computers, the last big item that required people to think, found success primarily in the business market, not in the home.

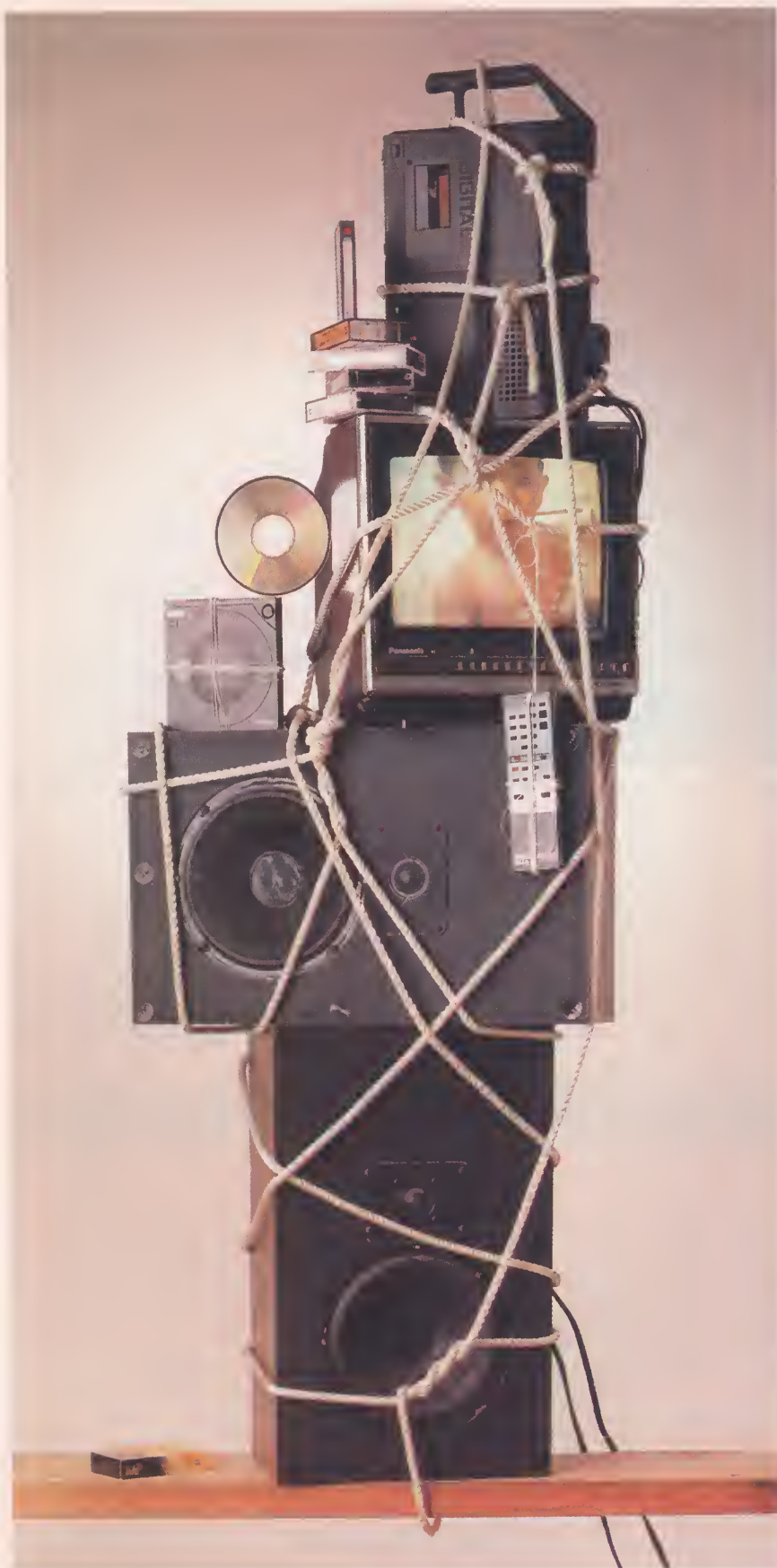
If CD-I demonstrates its appeal, however, the companies will have created a brand-new market that could be worth billions in the 1990s. Home-electronics companies will sell CD-I players the way they now sell stereo systems. Software suppliers will peddle next-generation computer games and interactive programs to run on the players. Publishers will have a new medium for entertaining and informing people. Even educators are expected to become part of the

industry, offering learning discs that teach via sight, sound, and text.

Because CD-I has no true antecedents, no one can reliably predict whether it will boom or bust. Market forecasts vary wildly. Link Resources, publisher of the industry newsletter *CD-I News*, expects U.S. sales to top 1 million units annually by 1992. On the other hand, CD-I advocate and electronics executive Almon Clegg of Denon says sales to consumers and businesses will reach about 5.4 million units by 1991. Meanwhile, doomsayers predict that CD-I won't significantly penetrate the consumer market for years to come.

"It's very difficult to get consumers to spend a lot of time interacting," says Michael Mascioni, journalist turned interactive-media consultant. "CD-I could be technological overkill in the consumer market."

The first CD-I products won't hit the market until late this year, at the earli-



est. After that, companies and market analysts say, it will take at least three years to ring up significant sales.

The companies with most at stake are Holland's Philips and Japan's Matsushita and Sony, all of which are developing CD-I players. Independent software companies firmly committed to the new technology include Spinnaker Software, Electronic Arts, and Tiger Media. California's Sun Microsystems and Apple Computers are developing workstations for programming CD-I discs. At this stage, it's impossible to calculate the total investment in the technology, but some observers say it easily tops \$100 million.

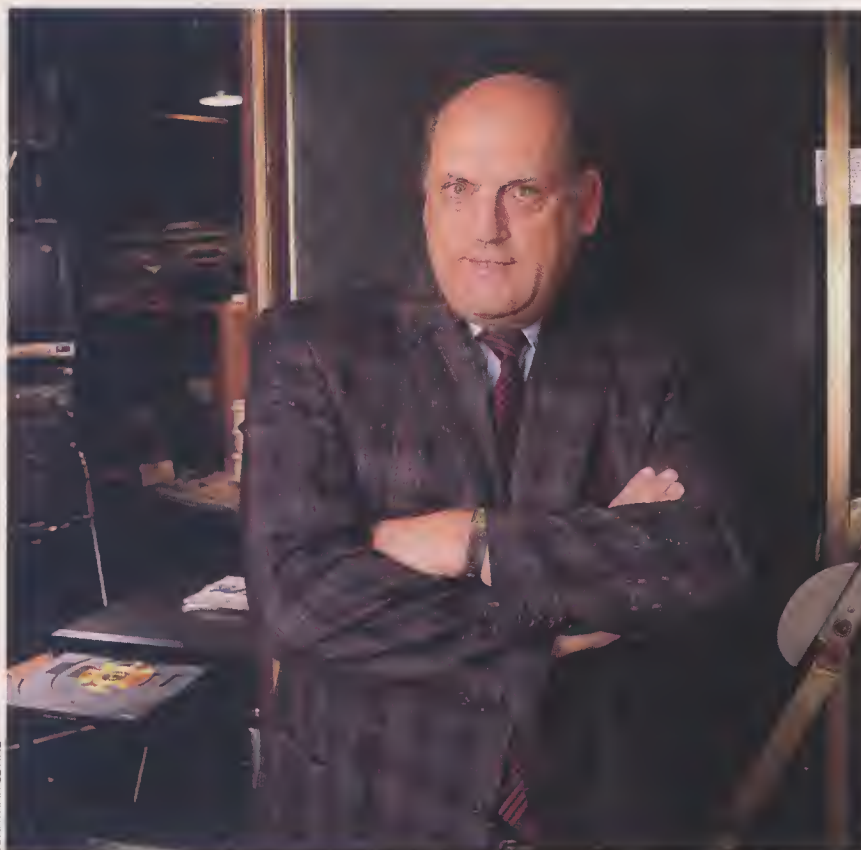
For world-class companies such as Philips and Sony, CD-I is clearly not a life-or-death gamble. Although Philips is tight-lipped about its investment in the technology, the company has spent at least \$30 million to develop software. Its recording subsidiary, Polygram, has set up American Interactive Media to explore CD-I programming opportunities. And though Philips can swallow the development costs if it has to, the company would no doubt view the failure of CD-I as a disappointing loss of potential revenue.

That potential is enormous. CD-I hardware would be a new addition to the splendidly prosperous consumer-electronics field. In 1986, U.S. consumers shelled out about \$40 billion for stereos, televisions, and the like, more than double what they spent only five years earlier, according to the Electronics Industries Association. CD-I could tie the home-video, computer-game, music, and computer-programming industries into a vast new software market. Intrigued with the technology's possibilities, about 500 companies have already paid \$5,000 each to join Philips' CD-I information network.

Despite the obvious interest, the uncertainty surrounding consumer acceptance of the new technology has kept all but a few companies from fully committing themselves to developing CD-I products.

To help soothe their fears, Philips is presenting CD-I as the next logical extension of audio compact discs. Philips and Sony jointly launched that technology in 1983, and industry-wide, CD-derived revenues have grown from \$15 million to \$630 million in 1986—primarily to consumers.

STEVEN MARK NEEDHAM



Jan Timmer, Philips' Consumer Electronics chairman, will head the market blitz expected this fall.

Philips is preparing an impressive offensive to help CD-I do even better. Tactics include enlisting support from other electronics companies, especially Sony and the other Japanese giant, Matsushita Electric, which markets products under the Panasonic, Quasar,

and Technics names. In a sense, Philips and Sony will own CD-I; together they developed a set of standards that will permit any CD-I player to play any software disc (see "Setting the Standards," below). Matsushita is developing microchips that will control the video signals

in CD-I. Other hardware and software companies are licensing the standards in order to create their own products.

The first products will no doubt come from Philips. The Dutch company hopes its Japanese development partners will join it soon, but neither Matsushita nor Sony have formally announced plans to introduce anything.

Sony is currently hamstrung by flagging sales of its Beta and 8-mm VCRs and camcorders, which are surrendering more and more market share to VHS-format machines. One insider says that because the company's video business segment, which is responsible for CD-I, isn't making money, Matsushita will probably introduce a player before Sony. However, Yoshio Aoki, director of Sony's advanced technology group in the United States, says Sony has developed CD-I player prototypes, and the company is ready with the encoding machines that will be used to stamp out CD-I discs.

Other Japanese companies will no doubt jump in if the concept starts to take off. Hitachi, Toshiba, and Sharp are considered most likely to join in early, because they already have considerable experience in compact-disc technology. Yamaha, Pioneer, and Sanyo could also have products on the shelves the moment CD-I starts to look like a winner. "Everyone knows how quickly the Japanese can jump on an emerging market," says Bert Gall, U.S. CD-I marketing manager for Philips.

Philips' initial concern centers not on hardware as much as on software availability. Relying heavily on its American Interactive Media (AIM) subsidiary,

THE COMPANIES SETTING THE STANDARDS

The driving force behind interactive compact discs is a team of companies with a track record of success: Philips and Sony. About five years ago, these two companies took consumers by storm when they jointly launched digital audio compact discs, a new music medium that provides better sound reproduction. In the United States, income from compact-disc players grew to about \$630 million just four years after the technology hit the retail shelves, and sales are still on the rise.

Sony and Philips are not the only beneficiaries of their creation. In order to quickly blanket the market with the new technology, they invited other companies to participate. But to ensure that all the new CD players were compatible, Philips and Sony wrote a rigid set of specifications and licensed them to the latecomers.

This standard-setting is a critical factor in the success of audio CDs. First, consumers don't have to choose between competing formats. More importantly, with only one standard to meet, recording companies can produce more offerings more quickly. That gives people more music to play on their new equipment, which in turn encourages more people to buy players.

The Philips/Sony team hopes to repeat this pattern with interactive compact discs. As of late 1987, about 75 companies had bought licenses to produce CD-I hardware or software. However, many of them are waiting to see how the market develops. "At this moment, there are really only a couple of brave companies that are really doing something," says Bert Gall, who is in charge of marketing CD-I for Philips in the United States.

CD-I's 10 HIGHEST ROLLERS

CD-I PLAYER MAKERS

COMPANY	CDI EXECUTIVE	1986 REVENUES	STRATEGY
Denon America 27 Law Dr. Fairfield, NJ 07006 (201) 575-7810	Robert Heiblim, senior vice president	\$100 million (U.S. operations only)	Has expressed commitment to CD-I, but is waiting for standards to solidify. Denon has made proposals to Philips regarding standards and feels there will not be only one player and disc.
Matsushita Electric Industrial 1 Panasonic Way Secaucus, NJ 07094 (201) 348-7000	Mark Horiki, director, CD-I development	\$28.7 billion (parent company in Japan)	Has not announced a CD-I introduction date. The company is developing the video processing chip for CD-I. Some say Matsushita will beat Sony to market.
Philips New Media Systems 1111 Northshore Dr. Knoxville, TN 37919 (615) 558-5110	Bert Gall, U.S. CD-I marketing manager	\$25 billion (parent company in the Netherlands)	Hopes to launch CD-I in late 1988, though observers think 1989 is more likely. Has probably invested the most in CD-I development, but is not expected to be a big player in the United States.
Sanyo 1200 W. Artesia Blvd. Compton, CA 90220 (201) 440-9300	Ken Mano, chief engineer	Not disclosed	Developing CD-I players. Has not announced introduction plans.
Sony Corporation of America 1003 Elwell Court Palo Alto, CA 94303 (415) 965-8700	Yoshio Aoki, director, advanced technology group	\$8.2 billion (parent company in Japan)	Has not set a CD-I introduction date. With over 30 percent of the U.S. audio-compact-disc market, Sony has the might to dominate CD-I, but losses from VCR sales may hamper CD-I rollout.
Thomson Consumer Product 5731 West Slauson Ave. Culver City, CA 90230 (213) 568-1002	Jose Hennard, deputy managing director, CD-I group	\$10 billion (parent company in France)	Developing CD-I players. Expects to ship products in 1989.

CD-I PROGRAM WRITERS

COMPANY	CDI EXECUTIVE	1986 REVENUES	STRATEGY
American Interactive Media 11111 Santa Monica Blvd. Los Angeles, CA 90025 (213) 473-4136	Bernard Luskin, president	Wholly owned by Polygram, the recording arm of Philips; revenues not disclosed	Developing CD-I software to complement Philips hardware. Plans to have 10 titles out by the end of 1988. Also serves as an industry catalyst to promote further software development.
Electronic Arts 1820 Gateway Dr. San Mateo, CA 94404 (415) 571-7171	Greg Riker, director of CD-I technology	Privately held; revenues not disclosed	Sees a broad range of opportunities in CD-I. Waiting for prototype hardware to solidify its plans. Programs may be extensions of its microcomputer products. Hopes to have products by mid-1988.
Spinnaker Software 1 Kendall Square Cambridge, MA 02139 (617) 494-1200	Richard Bratt, executive vice president	Privately held; revenues not disclosed	Developing four software products for CD-I, including a chess program and on SAT tutorial. Working with American Interactive Media, Spinnaker will have the necessary hardware to develop CD-I products.
Tiger Media 409 Jasmine Ave. Corona Del Mar, CA 92625 (714) 673-2786	Laura Buddine, president	Privately held; revenues not disclosed	Currently developing unidentified programs and production capability for CD-I. Also assists other companies with CD-I training, consultation, and development.

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

Philips plans to be ready with a catalog of more than 30 CD-I programs when the first players hit the market in late 1988 or early 1989. The offerings will be diverse, and most will be fun; the software company drew its creative staff from Southern California's film and recording industries. "It has to be entertainment oriented, because that's what consumers want," explains Gall.

Music programs, such as audio/video reviews of the lives of popular musi-

cians, will be an early staple. Along with Parker Brothers, AIM is working on CD-I versions of popular board games. AIM also plans to offer a fantasy adventure called *Dark Castle*. On a higher plane, AIM has teamed with the Smithsonian Institution to create an interactive "tour" that might be titled *Treasures of the Smithsonian*. AIM also emphasizes education and reference programs. For instance, the company will collaborate with publisher

Grollier on an unabridged encyclopedia contained on a single CD-I disc.

The software effort is receiving support from other companies as well. Electronic Arts, the leading U.S. supplier of computer games, is developing a CD-I line. "The trend in interactive electronic entertainment is toward more realistic audio and video, better performance, and more storage," says Greg Riker, Elec-

INTERACTIVE CDs IN ACTION

Take a digital compact-disc player, just like the ones that play music from Basie to Beethoven. Wire it to a television, then add a microprocessor-based control box. Presto: an interactive compact-disc system.

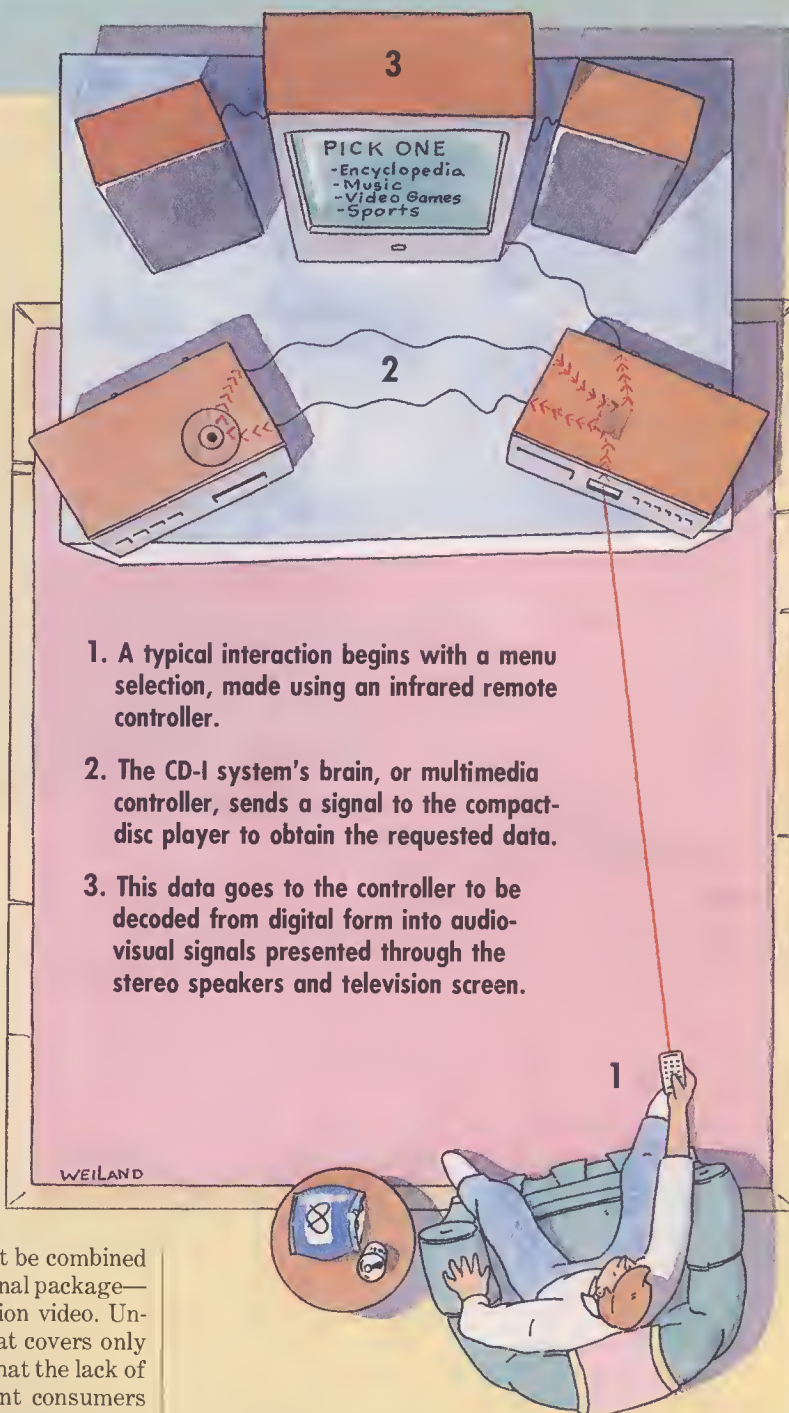
The major difference between compact disc-interactive (CD-I) and older audio and video discs is that control box. Because the computer helps the viewer interact with the disc, he or she can control what the program offers.

A CD-I program is more like a book than a record or tape; it can be opened to any page, for any time period and in any order. A viewer moves through the program by using on-screen menus, and makes choices with a pointing device such as an infrared remote controller. The interactive element lets a person get involved with the program by selecting certain parts or requesting more detail.

Actually a specialized computer, the microprocessor controller makes this possible by interpreting and coordinating the sound and picture signals coming out of the player. Like an audio CD, a CD-I stores information as digital patterns of microscopic pits on a compact disc. A laser device reads the pits and sends the information to the controller for decoding.

But CD-I squeezes various video images onto the disc along with the music. Using the same technology that the business computing world is parlaying into CD-ROM (compact disc-read only memory), CD-I discs can store enough audio and video data, plus digital control signals, for an encyclopedia's worth of sights, sounds, and information.

The image can include text—which might be combined with demonstrations in a how-to or educational package—still pictures, animation, and even full-motion video. Unfortunately, the video runs in a window that covers only about a sixth of the screen. Critics charge that the lack of full-screen, full-motion video will disappoint consumers spoiled by television. Although CD-I capitalizes most fully on the capacity of the Philips-developed compact discs, current technology can't store the enormous amount of data required for full-screen video on a compact disc. Philips and others are working to solve this problem. Their aim is to develop data-compression techniques that save space by putting abbreviated video data on a disc. Sophisticated processing in the multimedia controller would take up the slack, reconstructing a complete video signal to fill the screen with moving pictures. However, companies say



1. A typical interaction begins with a menu selection, made using an infrared remote controller.
2. The CD-I system's brain, or multimedia controller, sends a signal to the compact-disc player to obtain the requested data.
3. This data goes to the controller to be decoded from digital form into audio-visual signals presented through the stereo speakers and television screen.

the effort will take several years.

In addition to playing CD-I programs—which will include encyclopedias and reference discs, games and fantasy adventures, tour books, entertainment programs, and educational packages—CD-I players will accept standard music CDs, producing the same sound quality as dedicated audio-CD players. Marketers hope this compatibility will encourage audio-compact-disc owners to trade them in to take advantage of CD-I's greater capabilities.

CD-I IN BUSINESS

Home users may be unprepared for interactive compact discs, but in the business world, the new format will fit into a family of interactive video products already being used for tasks such as training and marketing.

"Initially, compact disc-interactive will have greater impact on the business market, because businesses can use it and they can afford it," says consultant Michael Mascioni. The ability to provide standardized software that can run on a large number of players should make compact disc-interactive, or CD-I, more attractive than competing interactive-video formats, he says.

Companies looking into business-oriented CD-I software include Softkey Software Products of Toronto, Reality Technologies of Philadelphia, and On-Line Computer Systems of Newport Beach, Calif.

Training is one logical application. CD-I-based systems would let students customize a training program for their particular needs—progressing at their own pace, repeat-

ing some sections, skipping over others.

In the retail market, stores could use CD-I systems to create product-information centers for shoppers. General Motors and Ford already use similar, computerized kiosks to promote their cars. But these generally mix media, carrying pictures on laser discs and vehicle data on a computer floppy disk. A simpler CD-I system would supply all the data from a single disc.

Mascioni maintains that by putting CD-I in public places such as stores, museums, and education centers, the system's creators will help ease entry into the home market.

Despite the business potential, most of the CD-I industry remains firmly committed to an assault on the consumer market. "The magnitude and velocity of the consumer market are so much greater than anywhere else," says Bernie Luskin, president of American Interactive Media, Philips' CD-I-software subsidiary. "The consumer market is the foundation," he says. "It will stimulate success in peripheral markets."

tronic Arts' director of CD-I technology, who contends that CD-I delivers all of these elements.

Philips is also paying careful attention to sales and distribution. "Our main focus is on selling CD-I products the way consumer electronics are commonly sold," Gall says. That means selling not through computer stores, but in upscale stereo shops and other places where people look for entertainment equipment.

To help build the installed base, Philips also is considering plans to stimulate software sales by including high-value programs with the machines themselves and establishing CD-I clubs to share software. The goal is to prompt companies to develop more programs, which will help push hardware sales. In short, Philips' strategy is to promote the same synergy that supports the VCR and movie-rental businesses, or the stereo-equipment business and the recording industry.

Philips has carefully avoided the kind of overly optimistic sales projections that plagued the home computer market. The company doesn't dream of matching the 98 percent penetration of television in the United States, or even the 40 percent mark attained by VCRs. "They're pretty realistic about sales in the first several years," observes David Fishman, senior analyst for consulting company Arthur D. Little.

According to Gall, initial buyers will be the "early adopters" who adore new

technologies and are driven by a first-kid-on-the-block competitiveness. But early adopters constitute only about 5 to 10 percent of the consumer market. To reach the mass market, says Gall, prices will have to drop to about \$500 from the initial level of \$1,500 to \$2,000. He expects to see such a price reduction in three to five years. Harold Vogel, securities analyst and vice president of Merrill Lynch, says companies such as Atari may eventually offer CD-I players for as little as \$200 to \$300.

To hit that mass market, software developers may also have to make the systems less interactive. Although a key CD-I selling point is that it plugs into standard television sets, many Americans use television as a means of sedation; they may find it difficult to talk back to the tube.

"We should not shoot toward too high a level of interactivity," says Gall. CD-I programs will probably allow people to opt for different levels of participation. There may even be a passive mode, in which viewers can merely watch a program from start to finish as they do a video tape.

CD-I will also have to win the attention of consumers at a time when new electronic products are arriving at a confusing pace. "To add another device and another standard is asking too much right now—it's almost impossible to keep up with the stuff," says Merrill

Lynch's Vogel. Audio compact discs, only five years old, are already about to be challenged by digital audio tape. On the video side, Sony continues to support the Beta and 8-mm formats against VHS and Compact VHS, and the recent introduction of Super VHS has set things spinning once again. Then there are camcorders, stereo TV, digital TV, CD-V, interactive video tape, new and improved players for home-computer games, and the spectre of high-definition TV.

Observers say the proliferation of formats means bewildered consumers and a very competitive market. Nevertheless, most marketers believe CD-I will catch on eventually; it's just a question of when. Philips, for one, is committed to waiting as long as it takes. "It might happen more slowly than we expect; that would be the worst scenario," says Gall.

The companies involved are pushing the concept as the answer to consumers' home-entertainment dreams. The cover of one promotional pamphlet depicts Alice plunging through a compact-disc-shaped looking glass into the wonder-filled world of interactive video.

But consumers are an ornery lot, not always willing to accept the best that technology has to offer. Companies might do well to reread the *Alice in Wonderland* stories; once Alice ventured into the alluring land beyond the looking glass, she couldn't wait to get back home. ■

Little Giants Win Space-Plane Contracts

New jet-engine technology creates big opportunities for small companies

BY T. A. HEPPENHEIMER

MULTIBILLION-DOLLAR aerospace projects usually get gobbled up by a select group of large, well-established defense contractors. Smaller companies must be content with scraps that fall from the table, in the form of subcontracts from the giants. But a \$3.3-billion government program to develop hypersonic test planes is giving birth to a new generation of technical leaders—especially several small entrepreneurial companies that have won high-visibility contracts for engine development.

The program, called the National Aerospace Plane (NASP), has awarded significant contracts to such little-known companies as Du Pont Aerospace, General Applied Science Labs, and Marquardt. At the same time, some of the giants are going hungry. For example, General Electric lost its bid for engine-development funding.

That's not to say that the competition to design the plane's engine is a showdown between small and large companies. Main contracts still remain in the hands of larger players. Nevertheless, the program has opened the door for lesser-known companies, giving them a strong shot at future revenues.

Their opportunity stems from the unprecedented technological challenge of NASP. The program aims to build an experimental aircraft, the X-30, that will far outstrip the speed and altitude capabilities of present-day aviation. The X-30 is to *fly* into orbit, eight times faster and five times higher than current rec-

ords. It will take off and land on a conventional horizontal runway.

The technology that should make this possible is an advanced jet engine called a scramjet. Though the scramjet concept has been around for a long time, larger companies abandoned it in favor of engine designs with more immediate markets. Now, the few small companies that stuck with the scramjet idea through years of obscurity have the technical footing to take on the giants.

The small contender with the greatest potential is Du Pont Aerospace, which designs specialty aircraft. Founder and president Anthony du Pont is the catalyst behind NASP. In the early 1980s, his calculations demonstrated that a plane could fly into orbit at hypersonic speed—more than 25 times the speed of sound—prompting the Pentagon's Defense Advanced Research Projects Agency (DARPA) to undertake the NASP program.

From 1985 through last year, NASP has been Du Pont Aerospace's mainstay. As the chief contractor in the program's first phase, the company worked closely with the government to define the basics of the aircraft. Du Pont won't reveal how much this meant in revenues, but the published NASP budget earmarked \$6 million for Phase 1 studies. Still, he says the company has yet to recoup the funds it has invested in hypersonic-flight research since its founding in 1969.

Now, however, Du Pont Aerospace

has a lesser role as the program moves into Phase 2, with companies developing competitive designs for the engine and airframe. Du Pont is prohibited from subcontracting with the larger aerospace companies working on development because, as DARPA maintains, its close association with the program would give an unfair advantage to its allies. Three companies—General Dynamics, Rockwell International, and McDonnell Douglas—have each won \$25.5-million contracts for competing airframe designs. Contending engine designs are in the hands of main contractors Rocketdyne (a Rockwell division) and Pratt & Whitney of Hartford, Conn., each with development contracts exceeding \$80 million.

"We insist on having multiple technical approaches in each of the problem areas," says NASP director Robert Williams. This strategy aims to prevent the kind of problems that arose from the fast-track approach that put the space shuttle's engine development in the hands of one company, Rocketdyne.

At the start of Phase 3 in the early 1990s, the government will pick one engine and one airframe concept and will award \$2.6 billion to build two X-30s. That's the stage at which Du Pont Aerospace hopes to win a payoff. "We started the whole thing," asserts du Pont. "We fully expect to jump into it as a business." He plans to win contracts for supplying some of the advanced components called for in the space plane's final design.

Despite Du Pont Aerospace's small

THE AEROSPACE-PLANE PAYOFF

Phase 1 (1984-1986):
NASP feasibility studies
\$6 million

Phase 2 (1986-1990):
Research and design studies
\$688 million

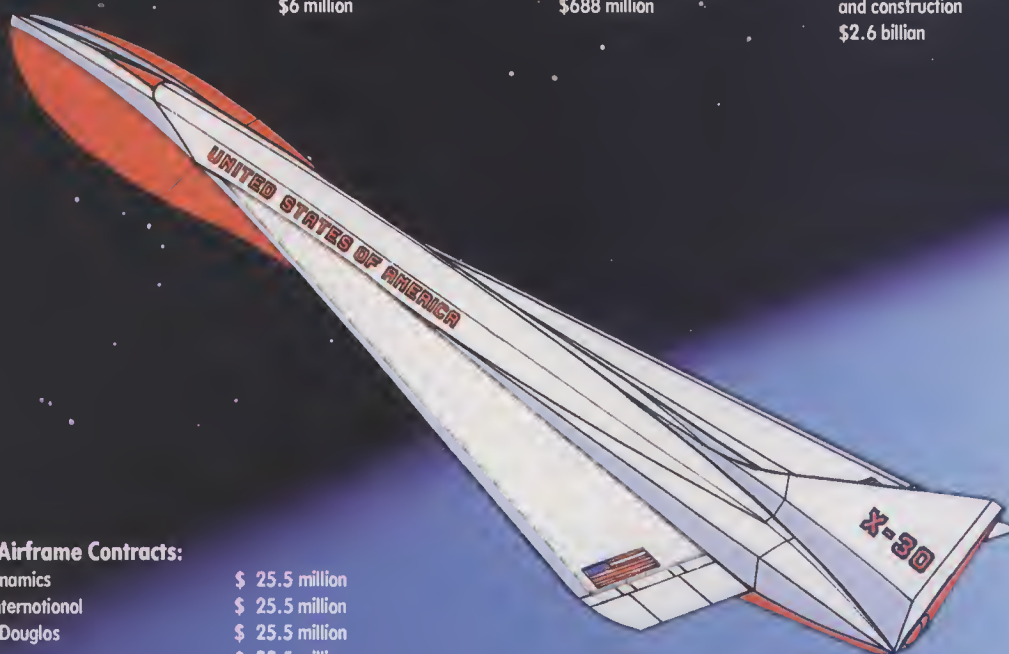
Phase 3 (after 1990):
X-30 aircraft development
and construction
\$2.6 billion

Phase 2 Airframe Contracts:

General Dynamics	\$ 25.5 million
Rockwell International	\$ 25.5 million
McDonnell Douglas	\$ 25.5 million
Other funds	\$ 33.5 million
Total	\$110 million

Phase 2 Scramjet Engine Contracts

Pratt & Whitney/Morquardt	\$110 million
Rocketdyne	\$ 85 million
GE/Aerojet Techsystems	\$ 30 million
Other funds	\$125 million
Total	\$350 million



size—the privately held company employs fewer than 30 people—the company is uniquely positioned to garner handsome NASP supply contracts. Hypersonic flight requires close integration of airframe and engine, and Du Pont Aerospace alone has extensive technical expertise in both areas. “We have a group of people who have been professionally involved on both sides of the fence,” says du Pont.

While Du Pont Aerospace must wait, other small companies are already reaping the rewards of Phase 2. As a junior member of Pratt & Whitney’s scramjet-development team, Marquardt gets \$18 million, plus an additional \$5.5 million to build a scramjet ground-test facility. The contract is long overdue; Marquardt pioneered scramjet research during the 1960s, but nearly went bank-

rupt when the engines fell from favor. It has achieved annual revenues of \$120 million by building small, specialized rocket motors as well as ramjet engines for Air Force missiles.

Involvement in NASP gives Marquardt its first solid opportunity in decades to emerge as a major engine developer. The company could garner hundreds of millions if scramjet-bred hypersonic flight becomes a reality. If its partner, Pratt & Whitney, gets the Phase 3 development contract, as much as \$200 million may go to Marquardt.

Also, a big payoff is in the wind for General Applied Science Laboratories, the only company that has remained committed to scramjet research since the 1960s. The \$3-million company has seen revenues double as a result of NASP, and its president, Ernest Sanlor-

enzo, expects another 50 to 100 percent rise as the program proceeds.

General Applied Science’s direct government funding is comparatively modest, but residual business could be immense. Because of its long-standing expertise in scramjet experimentation, General has been selected to take scramjet test facilities out of mothballs for NASA. In addition to upgrading, operating, and maintaining the facilities for government-funded tests, the company may hire them out to other companies. Already, General Applied Science has ongoing contracts to perform tests for one of the main engine companies, and is negotiating with the other.

The largest loser in the NASP program thus far may be Aerojet Techsystems, which lost out in the main engine development with its partner, Gen-

eral Electric. Although the company salvaged a \$6-million contract for a scramjet ground-test facility, it missed an opportunity to connect NASP scramjet work to its pet project, the air turbo-ranjet engine. This engine, largely of Aerojet's own design, would power planes at nearly twice the speed provided by conventional jet engines.

Aerojet's hopes for the engine were buoyed in recent years by multi-million-dollar development contracts from the Navy and NASA. With NASP, the company hoped to dovetail its advanced engine expertise with scramjet development to emerge as a leader in hypersonic propulsion. This scenario is now much less likely, with Aerojet and GE out of the running for primary NASP engine development. The company should remain a leader in liquid rocket motors, so its exclusion from NASP shouldn't hurt revenues. However, it has lost a major business opportunity.

Other small companies are also grab-

bing slices of the NASP pie. Garrett, for example, is developing scramjet fuel injectors, which must withstand extremely high temperatures. Also, Science Applications International receives \$2 million to create computer programs that simulate airflow within the engines. But the primary money makers so far remain the larger aerospace companies, mostly as a result of their greater resources.

The biggest revenue winner of the engine competition is Rocketdyne. In a bold stroke, Rocketdyne president Richard Schwartz staked nearly \$10 million of company funds on an unproven engine design—and won.

Traditionally, Rocketdyne has built rocket engines, not jets. When Phase 2 contracts were being reviewed in late 1985, the company didn't even try for a share of the \$350 million slated for engine development. Insiders figured contracts would go to the two teams that had participated in earlier feasibility

studies: Pratt & Whitney and Marquardt, and General Electric and Aerojet Techsystems.

But Rocketdyne was turned around by the commitment of an engineer who, as the story is told, championed his idea with the rugged individualism that gives birth to American business fables. The engineer—whom Schwartz refuses to name—came up with a way to apply Rocketdyne's rocket expertise to scramjets. The idea quickly worked its way up to Schwartz, who asked the government to give the novel scramjet design a look. In May 1986, DARPA said it would be happy to, if Rocketdyne would commit its own money to developing the idea.

As a latecomer to NASP and a novice in jet engines, Rocketdyne faced formidable odds. But Schwartz took the plunge, knowing that if he lost the contract, he'd probably lose his job. Today he's a NASP hero. In August 1987, Rocketdyne beat out GE for an \$85-mil-

AEROSPACE-PLANE ENGINE COMPANIES

COMPANY	FOUNDED	1986 REVENUES	NASP EXECUTIVE	NASP FUNDS	PRIMARY BUSINESS
Aerojet General, Techsystems Division Box 13222 Sacramento, CA 95813 (916) 355-3457	1942	\$760 million (Aerojet General)	Ron Samborsky, project manager	\$6.1 million	Liquid rocket engines
Du Pont Aerospace 7946 Ivonhoe Ave., Suite 316 La Jolla, CA 92037 (619) 456-7833	1969	About \$1 million	Anthony A. du Pont, president	Not disclosed	Research and consulting
General Applied Science Laboratories 77 Roynor Ave. Ronkonkoma, NY 11779 (516) 737-6100	1956	\$3 million	Ernest Sonlorenzo, senior vice president	\$5 million	Propulsion research and experimentation
Johns Hopkins, Applied Physics Laboratory Johns Hopkins Rd. Laurel, MD 20707 (301) 953-5000	1942	\$330 million	Fred Billig, assistant supervisor of aeronautics department	\$12 million	Contract research and development on naval systems
Marquardt 16555 Saticoy St. Van Nuys, CA 91409 (818) 989-6806	1945	\$120 million	Robert Budico, vice president of special programs	\$23.5 million	Propulsion systems
Pratt & Whitney, Govt. Engineering Division Box 109600 West Palm Beach, FL 33410 (305) 840-2000	1958	\$2.7 billion	Carl J. Sypniewski, NASP program manager	\$80 million	Propulsion systems
Rockwell International, Rocketdyne Division 6633 Canogo Ave. Canogo Park, CA 91304 (818) 710-6300	1955	\$700 million (est.)	Richard Schwartz, president	\$87 million	Liquid rocket engines
Science Applications International 10260 Campus Point Dr. San Diego, CA 92037 (617) 546-6000	1969	\$532 million	Sanford M. Dosh, technical director	\$2 million	Research, development, and engineering of integrated systems

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

THE POWER BEHIND THE PLANE

The scramjet engine, the key to the National Aerospace Plane, pushes the technological limits of jet propulsion. It is a variation of the jet engine that, in theory, can produce enough power to launch a spacecraft into orbit—a task that so far has been accomplished only by rocket engines.

In all jet aircraft engines, air flowing through the inlet is compressed, then heated by burning fuel. As this hot air escapes through the exhaust nozzle, it expands, generating the thrust that pushes a plane. In a conventional, turbojet engine, a spinning turbine compresses the incoming air. A ramjet engine relies on a plane's motion to ram air into the front opening at high speed. The same is true with a scramjet. However, scramjets are designed with internal airflow that prevents the extreme overheating that cripples a ramjet above Mach 6, which is six times the speed of sound.

Although simple in concept, this approach poses some daunting problems in aircraft design. Conventional jet engines are typically designed apart from the airplane body and attached later, just as an automobile engine is a separate, bolted-in component. But because scramjets need such a long air inlet, designers must integrate the inlet into the forward part of the airplane's body, the fuselage. Similarly, the rear portion of the fuselage serves as the exhaust nozzle. Thus, engine and fuselage become an integrated assembly that must be designed and developed as one unit.

The advantages of scramjets are expected to be worth the design effort, particularly if they can displace rockets for space flights. Rocket engines must carry the oxygen they need for combustion in tanks, adding considerable



ROCKY THIES

Anthony du Pont developed concepts that led to the space-plane program.

bulk to the spacecraft. But scramjets breathe oxygen from the air, and thus offer much better fuel economy, permitting small, lightweight craft to carry large payloads to orbit. Indeed, the scramjet promises to deliver the high speed of a rocket with the fuel efficiency of a jet—promise enough to lead the U.S. military and space community into a major development program.

lion contract to develop its scramjet. The other big winner, Pratt & Whitney, got a comparable award to develop its own scramjet. GE was left out in the cold, with little more than the \$26 million it received in 1986 to develop its losing scramjet design.

Although Rocketdyne escaped unscathed from the space shuttle controversies and still earns an estimated \$700 million in annual revenue, the NASP contract promises significant long-term benefits. In addition to the immediate \$85 million over three years and the possible \$1-billion X-30 engine contract, scramjet engines mean entry into a potential new business for Rocketdyne.

Pratt & Whitney, with its \$80-million prize, emerges from NASP as a major player in the world of advanced propulsion—a position it hasn't occupied since 1971, when it lost its bid to develop the space shuttle's main engines.

In the near term, the most promising payoff from NASP is a share of the \$2.6-

billion Phase 3 contracts. However, all participants should accrue some technological advantages that may result in commercial products. For instance, NASP research is delving heavily into advanced lightweight materials. The program is also pursuing a closer integration of airframe and engine, and pioneering the use of computers to create better aerodynamic designs.

Further, NASP is expected to lay the groundwork for a broad-based scramjet industry. It's too early to predict whether such an industry will indeed develop; many technical problems must be overcome before aircraft can handle the high-speed capabilities of scramjets. But if a commercial or military market should develop, NASP winners will have a promising head start.

To reap these technological rewards, more risk taking will be necessary. The three airframe contractors, for instance, are getting only \$25.5 million to develop such things as prototype wings

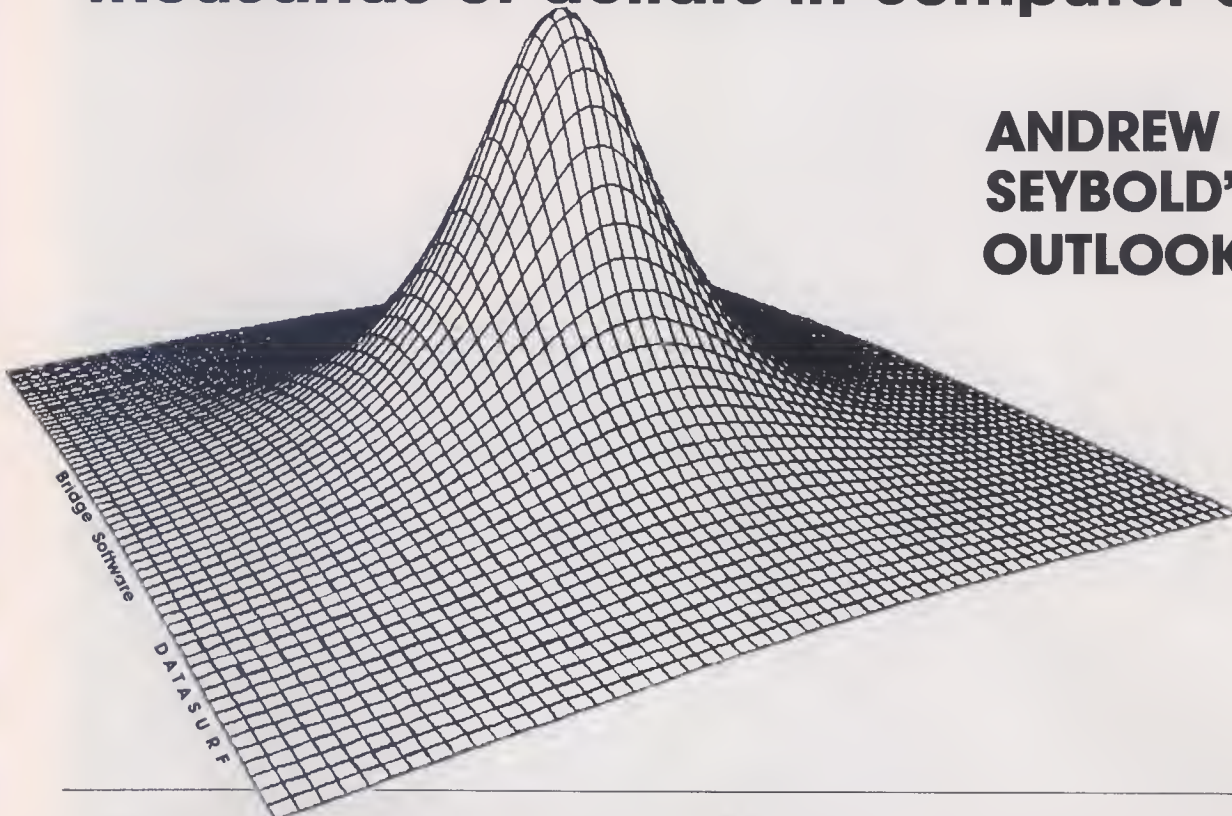
that incorporate novel cooling systems, frames that keep heat from leaking into super-cooled hydrogen fuel, and insulated fuel tanks that can stand up to repeated use. It's a tall order that will require each airframe contractor to match its federal money with as much as \$100 million in internal funds. Of course, the winner gets \$1.6 billion in Phase 3 contracts.

Thus, even when large companies are involved, entrepreneurial-style risks will remain an important element of success in the NASP program. Entrepreneurship, after all, is a legacy of the project, beginning with the musings of inventor and aircraft manufacturer du Pont. His pioneering work led to the creation of the project that so far promises to provide his company with a steady income at least into the 1990s. ■

T.A. Heppenheimer is a journalist and author specializing in aerospace and other technologies.

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ANDREW SEYBOLD'S OUTLOOK



The Vantage Point for Decision Makers on Information Systems

Andrew Seybold's Outlook On Professional Computing

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October 26, 1987

AT&T makes a major statement of direction
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AT&T's Bold Plan to Grab the Future

YOU'VE READ THE headline right. Drifting across the
page dimensions of the AT&T System is trying to be
a late-breaking Digital Equipment Corporation.
AT&T is also said, more to the point, is off and running
with a bold new plan to grab the future. AT&T has even
most said and has put its own business future together.
On October 5-7, at the first annual AT&T Industry Analysis
Conference in Houston, Texas, the company held up
this strategy for the world to see. Top officers who came by
and outlined the strategy. Included Vinton Cerami,
AT&T's number one computer man. It was face-to-face
with reporters, and the answers were as honest as
any I've ever heard. Here's a quick summary of what was
said on both sides.
(Continued on page 13)

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Biotech Targets Fight Back

As inventive players threaten existing products, some drug companies resist by co-opting the competition

BY FRANCESCA LUNZER

PHARMACEUTICAL companies spend, on average, about \$125 million to develop a new drug. They invest those millions in hopes of repeating the success of such drugs as Tagamet, an ulcer treatment that last year earned more than \$1 billion. They also hope that a given drug's market will stay secure, at least until the maker's patent expires.

But genetically engineered drugs are starting to make pharmaceutical companies look over their shoulders. Drugs that are derived from human and animal genetic material (and so may cause fewer side effects) have begun entering the market at a slow but accelerating clip, and are starting to steal sales from products whose patents will not expire for years.

That's a frightening prospect for the pharmaceutical industry, most of whose \$24.8 billion 1986 sales came from conventionally developed drugs.

However, the pharmaceutical companies plan to fight for their most lucrative markets. "The drug industry hasn't been asleep," says Linda Miller, an analyst who follows biotechnology for Paine Webber. "Their basic markets have been threatened, so they have been very aggressive in pursuing joint agreements and licensing agreements, and we'll see them continue to do that."

"The smart companies have been cannibalizing their own markets," continues Miller. "They've teamed with a company to make sure they were the first company marketing the bioengi-

neered product that would take their product off the shelf."

Many of the companies that missed their chance to team up with major biotech players are conducting similar research in their own labs, hoping that improved second-generation products and established sales and marketing teams will let them stay competitive. "There's incredible technology out there that [we



Product executive Joseph Trudelle holds Merck's hepatitis-B vaccine, which the company says outsells the original vaccine two to one.

are] paralleling with [our] own," says Joseph Trudelle, a product executive at Merck, Sharp and Dohme.

Perhaps the most prominent victim of the biotech battle has been insulin, which has been used for more than 50 years to treat diabetes. Insulin represents one of the biggest markets for

any pharmaceutical product; it is used by two million people in the United States alone, and 15,000 new users are added each year. These numbers add up to a \$480-million annual market. For Eli Lilly and Co., which owns more than 70 percent of that market, insulin brought in about 9 percent of its \$3.7-billion 1986 revenues.

Insulin has traditionally been derived from the pancreas tissue of animals. However, animal-based insulin has rapidly been losing ground to a product derived from human genetic material, called Humulin. Doctors increasingly prescribe human insulin for new patients because it's less likely to cause allergic reactions that may arise from impurities. Also, Humulin costs its users roughly the same as animal insulin, about \$240 per year. Paine Webber's Miller says there is no question that Humulin sales will continue to grow, because of the increasing number of new patients each year.

Lilly has covered its bases by getting an exclusive license to market Humulin from Genentech, the California company that developed it. As a result, Lilly has managed to retain and even slightly increase its market share.

Even though sales haven't been hurt, human insulin is less profitable for Lilly, because it must pay Genentech a royalty of about 10 percent on all Humulin sales, according to Miller. Despite that, the company has earned at least \$100 million from Humulin sales, estimates James McCamant, editor of

A.J. BERNSTEIN

the *Medical Technology Stock Letter*.

Lilly will probably maintain its grip on the market. Squibb-Novovo, which ranks second with a 20 percent market share, is at least two years away from bringing a human-insulin product to the United States, and Nordisk, a Danish company, which is testing a human insulin in Europe, has no plans to sell it here. Both Nordisk and Squibb produce a "semi-synthetic" insulin—pig insulin that is changed enzymatically to human insulin—but doctors appear to prefer the genetically engineered version.

Another target of biotech innovation is a hepatitis-B vaccine. Merck, Sharp and Dohme, which makes such a vaccine, has chosen a strategy similar to that followed by Lilly.

Merck introduced a proprietary hepatitis-B vaccine in 1982. However, because the drug was derived from blood plasma, rumor spread that it could cause AIDS. People refused to take the vaccine, even though many hospitals gave free inoculations.

But as Merck introduced its vaccine, it was funding development of a genetically engineered version based on research from Chiron Corp. and several university medical centers. This new vaccine, Recombivax B, was introduced in 1986. Both vaccines are still on the market, though together they have only been used to inoculate about a million of the 12 million people Merck estimates could use the products. At \$120 for the three-dose vaccine, Merck's product could make at least \$1.4 billion.

Even if Merck retires its original vaccine, it will probably have the market to itself, at least for a while. Although several biotech companies are developing hepatitis-B vaccines (including Amgen, Biogen, and Genentech), the company closest to producing another genetically engineered hepatitis-B vaccine for the U.S. market is SmithKline Beckman. A Belgian subsidiary, SmithKline Biologicals, has been marketing the Engerix-B vaccine in several countries, though it hasn't yet applied for approval here from the Food and Drug Administration.

Although Merck has co-opted the enemy, the market may not be as lucrative as it once looked. Merck must pay Chiron and the other developers a 5 to 6 percent licensing fee, by Miller's estimate, and a 6 to 10 percent fee to Biogen, which in December won a patent on the antigens used to make the vaccine. As with Humulin, however, the

biotech version of the vaccine is expected to prevail. In a recent statement to financial analysts, Merck's chairman, P. Roy Vagelos Jr., said Recombivax B is outselling the original plasma vaccine two to one.

A third battleground involves streptokinase and urokinase, blood-clot dissolvers manufactured by several companies. Both are considered vulnerable to an assault by TPA, a clot dissolver that has fewer side effects. The FDA approved Genentech's version of the drug, which will be marketed as Acti-vase, in November. However, TPA's market potential has been scaled down considerably from early analyst predictions of \$1 billion in annual sales. More realistic numbers seem to be in the \$200 million to \$300 million range. In the meantime, streptokinase's relatively low price—\$200 to \$250 per dose, compared to TPA's estimated \$2,000—is expected to keep it competitive.

■

*By forming teams, smart
companies have been first
to market challengers
to their own products.*

■

These are the most immediate potential victims of the biotech onslaught. However, a number of drugs are threatened by products farther down the pipeline.

For example, researchers at both Squibb and Merck have been looking at atrial natriuretic factor (ANF), a hormone secreted by the heart that fights some of the complications of congestive heart failure, including high blood pressure. Both Squibb and Merck make well-established drugs that could soon be challenged by Auriculin, a genetically engineered ANF developed by California Biotechnology Inc. of Mountain View, Calif. Observers estimate that, in just a few years, Auriculin could be approved to treat patients with congestive heart failure.

Such approval could reduce interest in Squibb's Capoten, which inhibits a substance that constricts blood vessels. Capoten is mainly used to treat high blood pressure, but a \$5-million second-

ary market comes from its use against congestive heart failure, which affects about 2.5 million people in the United States. Beginning this year, the drug is expected to face competition from Merck's Vasotech, another high-blood-pressure treatment that is awaiting FDA approval for use against congestive heart failure.

However, both Capoten and Vasotech can cause side effects, including excessively low blood pressure, and both must be used in combination with other drugs. Auriculin, which is still being tested, has demonstrated no side effects and seems likely to be used alone, which could reduce treatment costs.

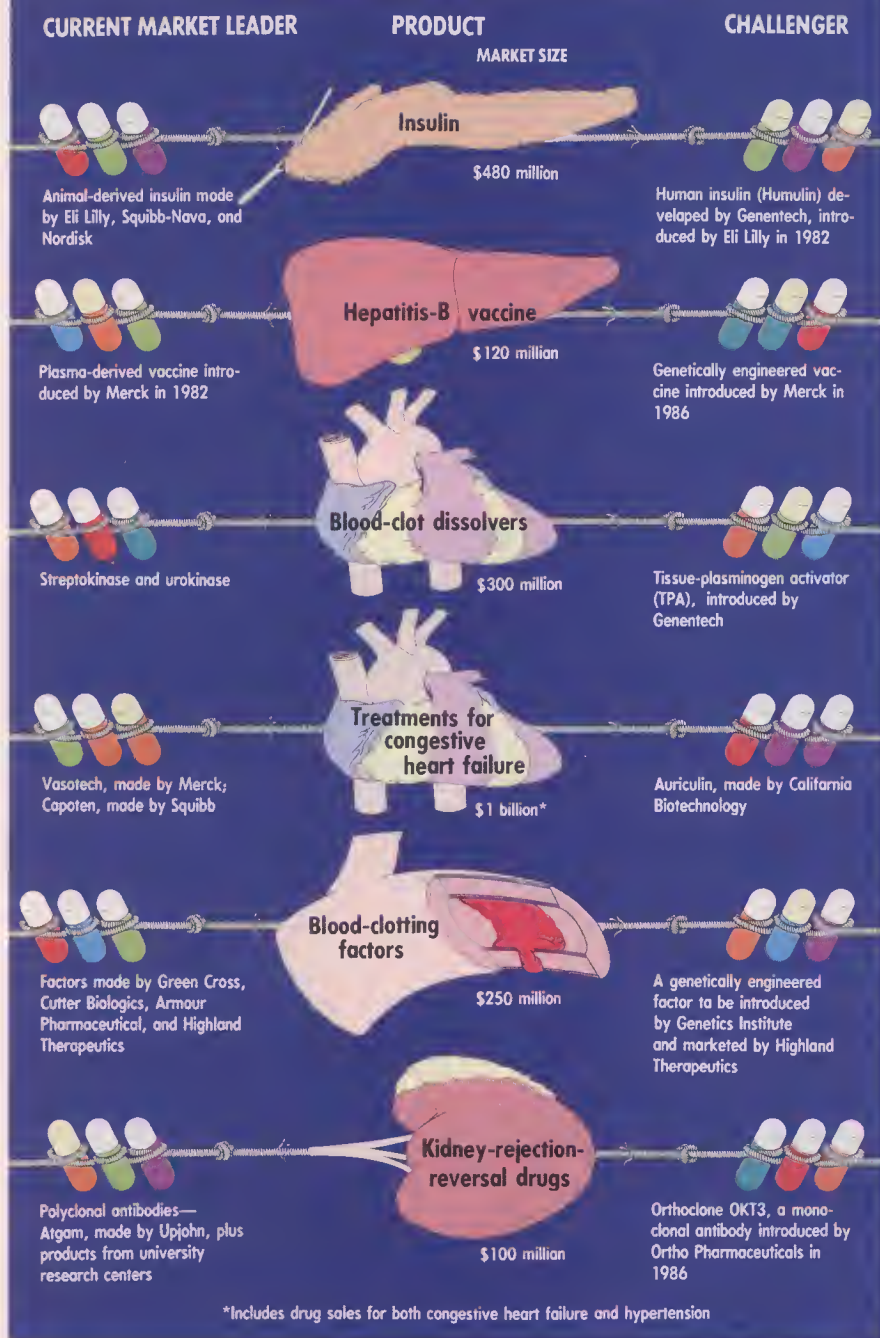
But Auriculin shares one major disadvantage of other recombinant-DNA products: If the drug is taken orally, the digestive system dissolves most of it before it reaches the bloodstream. This means Auriculin must be injected, an unpopular delivery method. Cal Bio is developing a nasal-spray version of the drug, as well as an oral version that would let people take the drug as a hypertensive to lower blood pressure. However, both the spray and oral form are far from being perfected.

Squibb's ANF research is very preliminary; the company is concentrating on the small amounts produced by the body itself. Merck has synthesized ANF that has been tested at the Mayo Clinic, and the company seems to be somewhat ahead of Squibb in its development schedule.

Also under fire from potential competitors are drugs that help clot the blood of 10,000 to 20,000 hemophiliacs in the United States. So far, this market belongs to Baxter Healthcare's Hyland Therapeutics division, Rorer Group's Armour Pharmaceutical Co., Green Cross of Japan, and Miles Inc.'s Cutter Biologicals; all make clotting factors from human plasma, a market estimated at about \$250 million. However, as with Merck's original hepatitis-B vaccine, there has been concern that the plasma-based clotting factor has helped spread AIDS. To counteract this fear, Armour Pharmaceutical last fall introduced a purer, though still plasma-based, version called Monoclolate.

But Genetics Institute of Cambridge, Mass., has produced a clotting factor that uses recombinant DNA rather than human plasma and thus would not carry the AIDS virus. This product is in clinical trials; Gustav Christensen, the company's senior vice president for

THE PHARMACEUTICAL TUG-OF-WAR



SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

commercial affairs, thinks it could reach the market by 1990. The drug will be sold by Highland Therapeutics, whose parent company, Baxter, also owns 6 percent of Genetics Institute and paid for the research costs.

These companies are not the only ones trying to get a recombinant clotting factor to market, however. Cutter Biologics has licensed Genentech's genetically engineered clotting factor,

though that product is believed to be at least several years behind Genetics Institute's. Armour Pharmaceutical is working on one as well.

Christensen says the Genetics Institute drug could initially cost more than the \$6,000 to \$8,000 a hemophiliac currently pays each year for the Factor VIII clotting drug. However, Armour's Monoclate costs about \$24,000 to \$40,000. Because most hemophiliacs in-

fected with the AIDS virus got it through contaminated clotting factors, insurance companies probably will not mind paying for a more expensive drug, in light of the long-term savings.

Perhaps the most convoluted competition is in a relatively small market—for drugs that help the body accept transplanted kidneys. Upjohn and several university medical centers dominate this \$24-million slice of the industry, but Ortho Pharmaceuticals, a division of Johnson & Johnson, has brought out a monoclonal antibody that can reverse rejection of a new kidney. The product, Orthoclone OKT3, has proved more effective than Upjohn's Atgam. Introduced in 1986, OKT3 is often the first-choice treatment for rejection of kidney transplants, and Ortho expects it to be approved this year for use in liver and heart transplants.

Despite these challenges to existing drugs, the invasion of genetically engineered drugs is tempered by several factors. No definitive decisions have been made on biotech product patents, even though many companies are working on the same products. If patents are granted on processes but not on products, companies could wind up sharing markets with many competitors.

Second, as TPA's developers can testify, the approval process can be painstakingly slow, and the leader in developing a drug for a given market may be overtaken by determined competitors.

Third, people dislike injections, and that's how most recombinant-DNA drugs are taken. Even if new drugs are superior, doctors may prescribe older ones if patients won't inject themselves.

Also, even though most analysts think genetically engineered drugs will probably cost the same as those produced by chemical synthesis, initial costs for staff, research, and manufacturing facilities can be high. To avoid such outlays, large pharmaceutical houses could license recombinant-DNA technology to develop the drugs, then use computer modeling to design new chemicals with similar effects, according to Mark Dibner, director of the North Carolina Biotechnology Center, a research facility.

But even taking these pitfalls into account, the potential market impact of genetically engineered products is profound. "Biotech drugs won't obviate classical pharmaceuticals," Dibner says, "but they could take over 20 percent of the market by the late 1990s." ■

MATT ZANG

THE HIGH TECHNOLOGY BUSINESS LEADING 100

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE		LATEST DIVIDEND (\$)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO				
AEROSPACE									
Gull (GLL/AMEX)	1/31	132.3	20.63	.11	-50.0	.05	21.3	1.05	69.3
Singer (SMF/NYSE)	2/30	78.2	53.00	.69	-10.4	.40	27.2	.53	1,835.0
Atlantic Research (ATRC/NASDAQ)	3/4	44.3	28.50	.60	53.8	—	13.8	.45	378.6
Prec. Aerotech (PAR/AMEX)	4/19	19.3	4.63	.11	-31.3	—	9.3	4.19	33.8
Gen. Motors H. (GMH/NYSE)	5/1	12.4	46.50	NA	NA	.72	NA	NA	NA
Motec (MXC/AMEX)	6/11	9.5	4.25	.02	NE	—	23.6	.23	20.3
AAR (AIR/NYSE)	7/21	8.5	17.50	.29	31.8	.36	16.4	.09	306.0
Langley (LCOR/NASDAQ)	8/15	8.0	6.75	.20	-4.8	.45	12.3	.00	12.2
Fairchild Ind. (FEN/NYSE)	9/27	6.0	8.88	-.32	NE	.20	NE	4.49	496.5
Martin Marietta (ML/NYSE)	10/12	5.0	39.25	1.02	10.9	1.10	9.7	.27	5,093.4
CHEMICALS									
Wellman (WLMN/NASDAQ)	1/78	62.0	20.25	.42	55.6	—	14.8	2.82	217.8
Genex (GNEX/NASDAQ)	2/66	58.7	1.19	.13	NE	—	NE	.07	1.6
Vista Chem. (VC/NYSE)	3/77	48.3	33.00	.83	93.0	.10	14.0	3.56	582.2
Georgia Gulf (GGC/NYSE)	4/73	37.4	45.00	1.92	242.9	.20	9.8	1.07	650.4
Aristech/Chem. (ARS/NYSE)	5/70	32.2	23.63	.72	67.4	.72	10.3	.19	864.6
Free Mc. (FTX/NYSE)	6/59	32.2	23.63	.68	209.1	.60	8.0	1.12	965.6
Huntington Intl. (HRLY/NASDAQ)	7/75	30.4	15.00	.31	47.6	—	14.6	.27	63.5
Fst. Miss. (FRM/NYSE)	8/65	30.0	13.00	.72	118.2	.24	9.8	.36	302.8
Intl. Genetic (IGE/NASDAQ)	9/72	29.1	2.75	-.08	NE	—	NE	.00	1.9
Dow Chemical (DOW/NYSE)	10/57	25.0	80.50	1.72	95.5	2.20	14.6	.66	12,571.0
COMMUNICATIONS									
Intl. Telecharge (ITIL/NASDAQ)	1/62	79.9	7.88	-.05	NE	—	NE	3.00	16.0
Tempo Enterpr. (TPO/AMEX)	2/42	55.6	7.00	.03	-50.0	.16	15.2	4.97	23.4
Graphic Scanning (GSCC/NASDAQ)	3/53	35.9	6.63	-.12	NE	—	5.8	1.79	115.2
Cellular Comm. (COMM/NASDAQ)	4/47	33.3	15.00	NC	NC	—	NE	2.64	NC
Vertex Comm. (VTEX/NASDAQ)	5/23	30.0	3.25	.09	12.5	—	9.8	.29	17.8
Digital Micro. (DMIC/NASDAQ)	6/39	22.9	14.75	.14	133.3	—	35.1	.14	30.3
Cinn. Bell (CSN/NYSE)	7/26	21.3	24.25	.43	-10.4	.96	12.8	.50	525.8
Telephone Data (TOS/AMEX)	8/54	20.9	26.00	.26	-53.6	.54	22.2	2.01	169.1
Wstin. Tele. (WTLCA/NASDAQ)	9/48	20.9	12.25	.06	-84.6	—	16.8	4.92	82.3
Alltel (AT/NYSE)	10/36	20.7	27.75	.74	21.3	1.52	14.7	1.21	726.0
COMPUTERS									
Decision Ind. (DIC/NYSE)	1/170	75.0	8.75	-.24	NE	—	NE	.01	189.3
Primoges (PRMG/OTC)	2/146	70.4	3.63	.02	NE	—	NE	2.22	5.3
Timeplex (TIX/NYSE)	3/75	68.7	29.75	.49	-44.3	—	17.2	.02	156.1
Franklin Cptr. (FDOS/NASDAQ)	4/105	64.1	10.88	-.03	NE	—	NE	.47	31.3
Novell (NOVL/NASDAQ)	5/141	46.2	19.00	.20	66.7	—	16.7	.02	153.8
Datapoint (DPT/NYSE)	6/176	42.9	5.00	.06	500.0	—	NE	.56	312.1
Radime PLC (ROOMY/OTC)	7/159	42.9	2.50	.04	NE	—	NE	.06	71.8
Apollo Cptr. (APCI/NASDAQ)	8/169	36.5	12.63	-.08	-100.0	—	27.4	.62	511.6
Micropolis (MLIS/NASDAQ)	9/138	35.1	19.25	.62	40.9	—	8.6	.00	259.7
3-Com (COMS/NASDAQ)	10/62	33.7	17.38	.23	64.3	—	20.4	.00	123.5
DRUG MANUFACTURERS									
Alpha One Bio. (ALBM/NASDAQ)	1/78	68.4	8.00	-.02	-100.0	—	61.5	.15	1.3
VLI (VLIS/NASDAQ)	2/10	61.6	6.06	.04	NE	—	NE	.00	20.4
Nature's Sunsh. (AMTC/NASDAQ)	3/43	55.6	10.50	.30	233.3	—	11.2	.08	36.6
Incstar (INUC/NASDAQ)	4/66	53.2	2.88	NC	NC	—	31.9	.12	NC
Biotechnica Intl. (BIOT/NASDAQ)	5/87	40.8	3.00	-.50	NE	—	NE	2.97	5.7
K V Pharm. (KVPH/NASDAQ)	6/72	36.4	15.00	.05	-28.6	—	NM	1.31	25.1
XOMA (XOMA/NASDAQ)	7/84	34.4	10.75	-.33	NE	—	NE	2.68	2.5
Par. Pharm. (PRX/NYSE)	8/48	33.3	17.50	.29	61.1	—	18.0	.33	78.7
Greenwich Ph. (GRPI/NASDAQ)	9/86	32.0	8.25	-.14	NE	—	NE	.00	.3
Thompson Med. (TM/NYSE)	10/65	30.3	14.50	.24	60.0	.40	13.2	.00	134.4

The following are the 10 companies in each of 10 industries that had the highest stock gain over the previous month (figures as of 11/27/87).

NE = Negative earnings NC = Not calculable NM = No meaningful figure

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE		LATEST DIVIDEND (\$)	P/E RATIO	OEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO				
ELECTRONICS									
Interand (IRND/NASDAQ)	1/246	100.0	3.00	-.19	NE	—	NE	.13	3.8
LaPointe Indus. (LPI/AMEX)	2/240	63.0	2.25	.05	NE	—	NE	.29	4.3
Astrocom (ACOM/NASDAQ)	3/193	56.0	1.56	-.04	-100.0	—	NE	.26	12.1
Westronix (WSTX/NASDAQ)	4/245	50.4	1.88	-.27	NE	—	NE	14.10	27.5
Wyle Labs (WYL/NYSE)	5/208	47.1	10.75	.14	75.0	.28	23.4	.32	337.7
Napco Sec. (NASC/NASDAQ)	6/186	45.8	8.75	.18	12.5	—	11.1	.26	28.2
Marshall Ind. (MI/NYSE)	7/183	45.2	14.88	.43	186.7	—	15.3	.76	305.6
Microdyne (MCDY/NASDAQ)	8/171	44.4	3.25	-.04	NE	.06	NE	.04	19.7
Xicor (XICO/NASDAQ)	9/242	43.9	7.38	.10	NE	—	33.5	.49	55.7
Integ. Device (IDTI/NASDAQ)	10/228	41.8	8.38	.09	800.0	—	36.4	.20	93.4
HEALTH									
Gish Biomedical (GISH/NASDAQ)	1/60	55.9	4.88	.09	350.0	—	13.9	.10	10.4
Bio-Medicus (BMDS/NASDAQ)	2/97	51.5	5.88	.03	-62.5	—	NM	.00	10.7
Biospherics (BSPR/NASDAQ)	3/12	50.0	8.25	.06	50.0	—	68.8	.04	9.8
Vipont Pharm. (VLAB/NASDAQ)	4/86	46.4	20.50	.23	283.3	—	36.6	.00	22.9
Sci. Leasing (SG/AMEX)	5/26	44.2	11.00	.11	120.0	—	45.8	2.40	51.8
Sunrise Medical (SNMD/NASDAQ)	6/105	41.2	6.00	.18	12.5	—	27.3	2.21	150.9
AOAC Labs (ADAC/NASDAQ)	7/80	37.0	1.63	.02	-94.3	—	27.1	.54	60.8
Amserv (AMSR/NASDAQ)	8/104	36.0	2.38	-1.77	NE	—	NE	5.67	5.8
St. Jude Med. (STJM/NASDAQ)	9/51	35.9	21.75	.42	35.5	—	14.0	.52	70.3
Cooper Cos. (COO/NYSE)	10/110	35.7	9.50	-.09	-100.0	.40	5.1	1.64	525.9
METALS FABRICATION									
Trinity Indus. (TRN/NYSE)	1/42	39.4	20.75	.06	-64.7	.50	90.2	1.28	516.9
Fla. Steel (FLS/NYSE)	2/38	32.2	24.13	.80	-16.7	.80	8.6	.22	381.0
Allegheny Lud. (ALS/NYSE)	3/33	26.7	20.75	.33	57.1	.10	10.8	11.07	813.0
Sifco Indus. (SIF/AMEX)	4/24	25.0	7.50	.58	286.7	.15	7.9	.37	63.1
Temtex Ind. (TMTX/NASDAQ)	5/19	25.0	5.00	.24	NE	—	20.0	.77	33.5
Wyman-Gordon (WYMN/NASDAQ)	6/27	20.8	14.50	.14	16.7	.80	NE	.07	324.3
Material Sci. (MSC/AMEX)	7/41	19.1	14.00	.30	-25.0	—	13.0	.74	144.4
Steel Tech. (STTX/NASDAQ)	8/37	16.1	18.00	.28	33.3	.03	17.3	.12	86.0
Graham (GHM/AMEX)	9/31	14.6	5.88	-.55	NE	—	4.6	.76	58.9
RB&W (RBW/AMEX)	10/39	14.3	4.00	-.29	NC	—	NE	.81	163.7
SCIENTIFIC AND ELECTRONIC INSTRUMENTS									
Sippican (SOSI/NASDAQ)	1/88	126.6	18.13	.21	-16.0	—	21.1	.03	55.7
Isamet (IOWT/OTC)	2/76	87.5	3.75	.00	-100.0	—	NE	.07	7.5
Detector Electr. (DETX/NASDAQ)	3/22	73.7	8.25	.02	NE	—	NE	.25	16.6
Newport Electr. (NEWE/NASDAQ)	4/90	57.6	3.75	.13	44.4	—	10.1	.04	14.2
Tenney Engr. (TNY/AMEX)	5/82	36.2	1.88	-.22	-100.0	—	NE	.44	18.4
Acuson (ACSN/NASDAQ)	6/75	32.6	14.25	.19	58.3	—	22.3	.01	93.6
Genetics Inst. (GENI/NASDAQ)	7/96	28.8	19.00	-.18	NE	—	NE	.06	21.3
KLA Instruments (KLAC/NASDAQ)	8/77	27.6	13.25	.09	-35.7	—	35.8	.00	89.5
Photonics (PHOT/NASDAQ)	9/94	26.0	3.63	.15	25.0	—	4.7	.73	14.1
Adams Rus. El. (ABI/AMEX)	10/79	25.8	9.75	-.23	-100.0	—	48.8	.06	130.8
SOFTWARE AND DATA PROCESSING									
Adobe Sys. (ADBE/NASDAQ)	1/140	76.3	26.00	.22	69.2	—	40.0	.00	30.8
Innovative Soft. (INSO/NASDAQ)	2/134	44.4	13.00	.20	185.7	—	21.0	.02	21.8
Technalysis (TECH/NASDAQ)	3/47	41.7	8.50	.21	16.7	.20	11.2	.00	14.3
Infarmix (IFMX/NASDAQ)	4/111	38.9	18.75	.21	90.9	—	33.5	.00	34.3
Autodesk (ACAD/NASDAQ)	5/133	38.5	18.00	.23	64.3	—	22.8	.00	71.8
Analysts Intl. (ANLY/NASDAQ)	6/113	37.0	6.00	.20	NE	—	6.9	.00	60.8
Software Pub. (SPCO/NASDAQ)	7/119	36.5	7.00	.20	185.7	—	10.1	.00	38.6
Oracle Sys. (ORCL/NASDAQ)	8/105	35.7	23.75	.10	900.0	—	40.3	.11	155.0
Comptek Rsch. (CTK/AMEX)	9/26	35.1	12.00	.17	88.9	.16	20.0	.08	40.0
Duquesne Sys. (DUQN/NASDAQ)	10/53	33.3	15.50	.20	42.9	—	20.7	.00	37.7

SOURCE: MEDIA GENERAL FINANCIAL SERVICES

Fiber Optics

The Rewiring of America

Phone companies run fiber to the customer's door, bringing new services and creating new markets

BY HERB BRODY

IMAGINE SMOOTH 12-lane highways linking America's major cities but ending in rutted, unpaved exit ramps and local streets. In effect, that's the state of today's telecommunications network.

Over the last five years, long-distance telecommunications companies such as AT&T, MCI, and US Sprint have laid thousands of miles of fiber-optic cable. Using light instead of electricity, these wispy strands of glass carry huge volumes of information—telephone conversations, computer data, and television pictures—faster, cheaper, and without the electronic noise that plagues traditional copper-wire and satellite transmission. A vigorous business has sprouted to supply the cables and optical electronics that make these fiber lines work.

But so far, these optical highways have had little impact on users; consumers have seen no dramatic new services. And the transmission quality touted by long-distance carriers remains compromised because the fiber highway does not extend to the end of the line.

Right now, communications signals that travel thousands of miles over fiber-optic cables end the journey over twisted pairs of copper wire—essentially the same stuff that has carried phone traffic for more than a century. As that copper wire gets replaced by fiber, consumers will see fundamental changes

in residential phone service.

Introducing fiber into this last stretch, a development no one doubts will occur, will pave the way for advanced services such as two-way video and multiple lines. Completing the fiber network will let more people work or bank more easily from their homes. It also could help automate utility-meter

reading, make possible a variety of remote security services, and slash phone companies' cable-maintenance costs.

Just as fiber to the home will raise revenue for telephone companies, experts say it is the only way to revive the slumping fiber-optic cable industry.

With the recent collapse of the long-haul fiber market, the fiber-optics industry desperately needs such a shot in the arm. According to John Kessler, president of Kessler Marketing Intelligence, the long-haul fiber-optic systems market will plummet from a peak of about \$225 million in 1986 to less than \$50 million by 1992.

The demise of the long-distance fiber market resulted from the completion of the national fiber-optic networks built by the long-distance carriers from 1984 to 1986. "More than 80 percent of the homes in the country are now within 50 miles of a fiber-optic trunk," says Wayne Gibson, senior product planning manager at Siecor, a maker of fiber-optic cable owned jointly by Corning Glass Works and the West German electronics giant Siemens AG.

But the market for systems that bring fiber to the customer's premises—businesses as well as homes—is just getting started. Kessler expects this market to leap from less than \$1 million in 1986 to top \$1 billion by 1992.

"This is the payoff," says Walter Ens Dorf, product planning director at

FIBER-OPTIC CABLE IN THE LOCAL LOOP



AT&T Network Systems, which makes fiber and transmission hardware for AT&T. "When companies got into the business 10 years ago, this is what they were counting on happening."

Over the last year or two, fiber has wormed its way from the long-haul network into the "feeder" part of the network, which sends signals from the telephone company's central switching office to remote terminals. However, the final link to individual residences—what phone companies call the "local loop"—is still copper. "There's 10 times as much business in the loop as there was in the inter-office network," says Russell DeWitt, director of technology assessment at Contel, an independent telephone company.

When the local market takes off, AT&T and Sincor, which together control more than 90 percent of the optical-cable business, may find that their biggest problem is keeping up with demand. About two million new and replacement lines are needed each year. If optical systems went into even half of those new lines, telephone companies would have to lay almost three million miles of optical fiber—about 50 percent more than the combined production capacity of all U.S. fiber-making facilities.

That hasn't happened yet, but the transition is beginning. Several phone companies—some that had been part of the old Bell System as well as independents—have begun to string fiber-optic cable to homes in trial systems. Virtually every telephone company not already involved with a fiber-to-the-home project has announced plans to begin one, or at least examine the idea.

But despite the sudden rush of trials, most analysts predict that only a relatively few homes will get fiber connections before the early 1990s. Fiber-optic technology must clear significant economic hurdles before phone companies will

find it worthwhile to completely replace copper to individual residences. Most phone companies, says telecommunications market watcher Michael Miller of Northern Business Systems, have just completed major capital investments in new switching equipment, and they're not eager to throw vast amounts of cash at a technology whose return has yet to be proven.

Fiber optics for the home still costs one-and-a-half to three times as much as a copper system. True, the price of fiber-optic cable itself has plunged in recent years; it now costs only 15 to 20 percent more than copper.

But fiber makers must still figure out how to pack more fibers in a cable, so fewer cables can serve a fairly large population center. Sincor now makes a 192-fiber cable and is shooting for a 600-strand version. The Japanese are reportedly working on cables with thousands of fibers.

Unlike long-haul systems, however, the cost of a fiber-optic system to the home depends mainly on the terminals at either end of the line. Each terminal must convert electronic pulses from the telephone receiver into bursts of light that can be sent over the fiber-optic line. The optical transceivers that do this still cost about 50 percent more than conventional electrical equipment.

AT&T Network Systems and Northern Telecom dominate the market for optical transmitters and receivers. Con-

tel and Southwestern Bell will use AT&T equipment for their trials; Northern Telecom won the contract for Southern Bell's project. Other makers of fiber-optic electronics, including Rockwell, NEC, Fujitsu, and Harris, may also come out with subscriber-loop products once the market solidifies. As more competitors enter the market, prices should fall.

Until then, the high cost of fiber-optic systems presents the phone companies with a dilemma. It will be difficult to recoup the extra costs if fiber merely supplies what the industry calls "POTS"—plain old telephone service. "Fiber optics is not yet justified for POTS alone," says Stanley Chum, director of communications systems technology at Pacific Bell. Consumers will not want to pay extra for a dial tone just because it's delivered optically.

Although most observers predict more new telecommunications services will be offered, the public demand for huge volumes of information in the home has been muted at best. For example, the Beaudin family of the rural Manitoba village of Sainte Eustache was one of the first in the world to enjoy

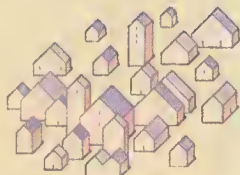


ILLUSTRATIONS BY MARK FISHER

FIBER-OPTIC TRANSMITTERS & RECEIVERS IN THE LOCAL LOOP

1992

1987



\$800,000

\$1 billion

AT&T Network Systems
Box 1278
Morristown, NJ 07960
(800) 372-2447

Fujitsu America
Telecommunications
Division
3055 Orchard Dr.
San Jose, CA 95134
(408) 946-8777

Harris
Farinon Division
1691 Bayport Ave.
San Carlos, CA 94070
(415) 594-3000

NEC America
Radio & Transmission
Division
2740 Prosperity Dr.
Fairfax, VA 22031
(703) 698-5540

Northern Telecom
1 Rovinia Dr.
Atlanta, GA 30346
(404) 395-5400

Rockwell International
Telecommunications
Division
1200 N. Alma Rd.
Richardson, TX 75081
(214) 996-5000

the benefits of fiber optics in the home when its house was wired with fiber as part of an experiment conducted several years ago by the Canadian Department of Communications.

Fiber brought the Beaudin family its first taste of private phone service after a traditional rural life of party lines. The family liked that, but "a lot of what the system provided was for farmers—the latest crop and livestock prices," recalls Michelle Beaudin; both she and her husband, Flo, are schoolteachers. Mostly, she says, her children played the video games the system offered. "They also offered stuff like knitting patterns," she says, "but I found it easier to get the pattern out of a magazine."

The Beaudins received the fiber-optic services at no charge. When asked whether she would pay for them, Mrs. Beaudin replied, "No, I would not."

But even if new services are wanted, fiber is not always necessary to add them. As market watcher Mark Lutkowitz, president of Trans-Formation Inc., points out, "There aren't many services that cannot be delivered over copper."

Video is a key exception. Because of the demonstrated demand for video programming, it appears that delivery

of video will be the most common initial service for fiber optics in the home. The same fiber that handles a house's phone traffic could also transmit cable-television programming. Digitized TV sent over fiber-optic lines would eliminate the picture-quality problems common in analog systems using coaxial cable. Fujitsu is working on such a system, which would also transmit high-fidelity stereo sound rivaling that from compact discs.

There are problems, however. The judicial ruling that busted up Ma Bell specifically prohibits local phone companies from offering video programming. It would be illegal, for example, for any of the regional Bell holding companies to go into business as a cable-TV operator.

But nothing prevents phone companies from renting their transmission capacity to cable-TV companies, and this is exactly what is happening in at least two pilot installations. Southern Bell will install fiber in each of the 4,000 homes that are to be built in a luxury housing development called Heathrow, near Orlando, Fla. Heathrow Telecommunications, a subsidiary of the company building the 3,000-acre community, will provide cable-TV programming over fiber lines leased from Southern Bell.

A more complicated proposal has drawn fire in the California town of Cerritos. There, General Telephone of California plans to lay fiber to about 5,000 homes. General Telephone will lease half the fiber's capacity to Apollo Cable. The phone company's parent organization, GTE Services Corp., plans to use the remaining capacity to supply a vaguely defined service it calls "video on demand." With it, subscribers could phone requests to a separate company, which would keep a library of thousands of videotapes and videodiscs and supply the programming desired.

The National Cable Television Association has attacked the planned system. "Phone companies are not allowed to provide video programming," says Lynn McReynolds, the association's director of public affairs. If video on demand is not really a cable-TV service, the association maintains, then General Telephone is guilty of overbuilding the network. "The FCC says the telephone company has got to have a client for its excess capacity," says McReynolds.

General Telephone of California denies that the Cerritos system would put it in the cable-TV business. "We're just providing the highway," says Darrell

Hughes, director of business operations. "It's up to somebody else to put the cars and trucks on it."

The issue could be critical. Miller of Northern Business Systems contends that phone companies will find it appealing to install fiber optics in the local loop "if and when they are let into the cable-TV business." Other services such as automated meter-reading, home banking, and security would bring negligible income to the phone companies, Miller asserts.

But phone industry visionaries see more for fiber optics than potential cable-TV competition. "A fiber-optic hookup could be extremely useful for the home office," says Paul Shumate, manager of systems technology research at Bell Communications Research, the central research-and-development organization of the former Bell telephone companies.

"Let's say you're doing a spreadsheet on your computer at home," he suggests. "Now your headquarters calls. You push a couple of keys, and the spreadsheet disappears, replaced by a full-motion video of the person who's calling you. The two of you talk about some project you're working on. He pushes a button and transmits a chart,

FIBER-OPTIC CONNECTORS IN THE LOCAL LOOP

1992

1987



\$30,000

\$91 million

Amp
Box 3608
Harrisburg, PA 17105
(717) 564-0100

AT&T Network Systems
Box 1278
Morristown, NJ 07960
(800) 372-2447

Darran/3M
165 First Ave.
Atlantic Highlands,
NJ 07716
(201) 291-8103

SOURCE: KESSLER
MARKETING INTELLIGENCE

TELEPHONE COMPANIES TEST FIBER OPTICS

UNITED STATES

COMPANY	LOCATION	NUMBER OF HOMES	EQUIPMENT SUPPLIER	STARTS OPERATION	SERVICES OFFERED	COMMENTS
Contel	An undisclosed city in New York state	600	AT&T	October 1988	Basic telephone service	Replacing existing copper cable
Contel	An undisclosed community in California	400	AT&T	October 1988	Basic telephone service	New housing development
General Telephone of California	Cerritos, California	5,000	Not disclosed	By December 1988	Video on demand, home banking and shopping, security, utility meter-reading	Video services to be supplied by Apollo CableVision
Illinois Bell	An upscale suburban development, to be selected	Not available	Undecided	Late 1988	Basic telephone service	Will expand to include enhanced services
Southern Bell	Heathrow, Florida	150 to start, then about 200 per year; final goal: 4,000	Northern Telecom	June 1988	Voice, data, security, meter-reading, and energy management. Cable TV starts March 1989	Will be among the first residential tests of ISDN
Southwestern Bell	Leawood, Kansas	50 to 100	AT&T	October 1988	Basic telephone service	If successful, Southwestern Bell will switch to fiber for all new housing developments

OTHER COUNTRIES

COMPANY	LOCATION	NUMBER OF HOMES	EQUIPMENT SUPPLIER	BEGAN OPERATION	SERVICES OFFERED	COMMENTS
Deutsche Bundespost	Berlin, Dusseldorf, Hamburg, Munich, Nuremberg, and Stuttgart; West Germany	About 300	Siemens, Standard Elektrik Lorenz, Tekade, Fuba, Ant	1983	TV, facsimile, telephone, videotex	Fiber in subscriber loop ties into fiber-optic trunks between cities; only about 20% of subscribers have video service
France Telecom	Biarritz, France	4,000	Societe Anonyme de Telecommunications	1984	Picture phones, videotex	Subsidized by French government; one of the first "fibered cities"
Japanese Ministry of International Trade & Industry	Higashi-Ikoma, Japan	158	Several Japanese telecommunications-equipment companies, including NEC and Hitachi	1978	Cable TV, two-way video, video on demand, videotex	Called Hi-Ovis, for Highly Interactive Optical Visual Information System
Manitoba Telephone	Eli and Sainte Eustache, Manitoba, Canada	150, including businesses	Northern Telecom	Operated 1981-83	Basic telephone service, cable TV, videotex	Subsidized by Canadian Department of Communications

which appears in one corner of the screen. When you hang up the phone, the spreadsheet reappears."

Fiber would bring personal uses as well. "Maybe your company is transferring you to another city," Shumate says, "and you need to find a house. You call a real-estate broker in the new city. While she's talking, she transmits still photos of various homes. When one sounds and looks good, the broker can transmit a short clip of motion video—letting you 'walk through' a house thousands of miles away."

Independent telephone company Alltel is checking into the possibility of

stringing fiber optics to an upscale retirement home in Ohio. Wayne Zwald, Alltel's vice president for technical services, says the communications system would furnish retirees with interactive services that would minimize their need to leave the building.

Beyond the high-tech glitter, fiber promises long-term economic advantages as well. Fiber optics' greater capacity makes it much easier to provide additional phone lines to a residence at a reasonable cost. With copper, a new line requires expensive physical installation of another twisted-pair cable, one reason why only 5 percent of U.S. homes

now have more than one line. With lightwave transmission, many independent phone lines can exist on one fiber, at a token additional cost. Cost comparisons already favor the use of fiber in new homes that have multiple lines, says Richard Snelling, the Southern Bell executive who has led that company's charge toward fibered homes.

Cost-effective extra lines are critical to home-security systems. Burglar and smoke alarms are most effective when they automatically call the police or fire department upon detecting something amiss. To be practical, this requires a separate line reserved for the alarm. An

HOW FIBER OPTICS WORKS

Fiber optics replaces electricity with light, and copper wires with hair-thin strands of glass.

A fiber-optic transmitter encodes information—computer data, human voices, text, or pictures—into modulated light waves. A tiny laser or light-emitting diode squirts the light (actually infrared energy, at a wavelength invisible to the eye) into a strand of ultrapure glass called an optical fiber. The glass confines the light waves to a narrow core region. The beam shoots down this optical tunnel by repeatedly bouncing off the glassy walls.

Optical fibers are phenomenally transparent. If seawater were as clear, the ocean bottom would be as easy to see as the floor of a swimming pool.

At the other end of the fiber, a photodetector picks up the light and transforms the optical information back into electronic energy. Ideally, the electronic signal that comes out of the photodetector exactly matches the electronic signal fed into the transmitting laser.

Fiber's biggest advantage lies in its ability to carry far

more information in a given time than can the twisted pair of copper wires traditionally used by telephone companies. Several signals at once can be fed into the fiber, and light pulses sent in extremely rapid succession will remain separate and distinct even after traveling through many miles of fiber. Electrical signals, by contrast, tend to smear into each other after a comparatively short journey through copper wire.

A single optical fiber can carry hundreds of simultaneous telephone conversations or their equivalent in computer data or television pictures. Telecommunications researchers have been jumping through hoops to make copper wire carry even two simultaneous conversations.

Fiber also improves transmission quality, because light waves zip through fiber unaffected by the electrical interference that can muddy signals passing through copper. Fiber also helps ensure privacy; light waves streaming through fiber stay entirely inside the fiber, whereas copper wires leak radio waves that snoopers can detect.



through fiber unaffected by the electrical interference that can muddy signals passing through copper. Fiber also helps ensure privacy; light waves streaming through fiber stay entirely inside the fiber, whereas copper wires leak radio waves that snoopers can detect.

DICK LURIA/STOCK SHOP

optical fiber has ample room for a security channel that would continually send a central monitoring station an update on the home's status, indicating whether anyone has broken in or smoke has been detected.

Of course, the emerging standard for an integrated services digital network, or ISDN, would offer the equivalent of two lines over standard copper wiring, but fiber optics could turn out to be more flexible, cheaper, and a more immediate option than ISDN for home use.

Scared off by the uncertain demand and regulatory thickets that obscure the delivery of advanced services, several phone companies are focusing their initial fiber-to-the-home projects on regular telephone service. "Until the regulatory issues die down, we'll stick with POTS," says George P. Lynch, manager of new technologies for Illinois Bell. The company has announced plans to run fiber optics to an upscale suburban community sometime this year.

Southwestern Bell is running fiber to 50 to 100 homes in Leawood, Kan., to "justify fiber for POTS only," says Myron Keller, area manager for loop technology planning. If the Leawood trial works out as planned, Keller says, Southwestern Bell will begin using fiber in all new housing developments.

Despite fiber's initially higher costs, lower maintenance expenses should help balance the equation. When conventional copper cable sits in water, corrosion can eat right through the metal, notes Keller. He estimates that avoiding corrosion could save phone companies as much as half their cable maintenance costs, which average \$20 to \$40 per year per customer.

Still, fiber is penetrating the home market at a stately pace. "It will be the year 2020 before fiber reaches into one-third of U.S. homes," predicts Michel Guite, vice president and telecommunications analyst for Salomon Brothers. Because of the cost and regulatory barriers, most phone companies are limiting their fiber-optic forays to new housing developments, as is the case with the Southern Bell and Southwestern Bell trials. In a departure from this trend, Contel will run fiber to 600 existing homes in an unidentified New York state community this fall. Contel is also installing fiber-optic links to 400 new homes in California.

Progress is expected to be slow because many U.S. phone companies are still sitting on the fence. Contel, for example, is "watching the other phone companies," says strategic planning manager John Clark. Southern New

England Telephone continues to "study the technology and look to see whether there is a market for new services," says Pamela Patry, manager of network strategic planning.

Progress has been faster in other countries where centralized telecommunications authorities don't have to worry about competitive pressures. As early as 1980, Canada, France, West Germany, England, and Japan began rigging selected towns with fiber to test the technology and evaluate new services. However, heavy government subsidies on telecommunications in those countries make it difficult to use their tests to draw economic conclusions for the U.S. market.

But momentum is building here. By the end of this year, optical fibers will be spilling their bounty of information into several thousand U.S. homes.

The immediate payback may not be obvious; it's hard to tell whether consumers will be willing to pay for services that have yet to be offered. But proponents are confident that once consumers taste inexpensive access to video services, multi-line telephone service, rapid data access, and even picture phones, there will be no turning back. Says Pacific Bell's Chum, "Fiber will buy us the future."

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Computers Invade The Executive Suite

*Executive information systems bring the
top brass into the computer age*

BY HERB BRODY

FOR THE PAST two years, oil executive Robert G. Wallace has begun his work day gazing at the computer screen. "My wife said I was crazy to get a computer in my office," recalls Wallace, executive vice president of Phillips Petroleum. The 61-year-old executive had doubts of his own, too: "I was brought up with slide rules—even the pocket calculator took a lot of getting used to."

Despite the apprehension common for business people of his generation, Wallace took the plunge. The lure: an executive information system created by Phillips for its top staff. The system lets him check the state of the company's oil and chemicals businesses and gives him quick peeks at world news. By offering immediate access to information that he previously obtained from a variety of sources, Wallace figures the system saves him about an hour a day. "This is the kind of thing that will make American companies more competitive," he says.

The executive information system, or EIS, is giving computers a toehold in the last bastion of computer phobia in corporate America. These systems distill for their high-ranking users an up-to-the-minute glimpse of all the enterprise's crucial elements. Essentially, such systems show executives the for-



*Phillips Petroleum executive
Robert Wallace saves an hour a day.*

est and give them the option of picking out individual trees.

As computers trickle up into the offices of chairmen, CEOs, and vice presidents, they crack open the door to a new subsegment of the software industry. Like Wallace's system, most executive information systems now in use were pieced together by the computing departments of the organizations that use them. In the past year, however, several companies have begun selling such systems to outside customers.

Sales of such systems amounted to about \$30 million in 1987, according to International Data Corp. analyst Ted Jastremski. By 1990, Jastremski says, companies that sell them will pull in

about \$115 million.

Comshare and Pilot Executive Software, the early leaders in the commercial market, now control about 80 percent of the business. But that dominance may be short-lived as new suppliers begin to offer less expensive systems.

To make room for the new players, companies must expand their market by changing the very perception of what computers do. Most computers help lower-level employees with clerical work such as typing and accounting transactions. Such chores seldom interest executives, and EIS companies are gambling that they can make computers

do the kind of things that will bring top officials to the screen.

"Executives don't want to type," says Michael Wilkinson, manager for information technology at management consultant firm Arthur Young, which is cooperating with Southern Electric International to market an executive information system. "We take that as a given."

Essentially, an executive information system consists of mainframe-computer software that summarizes information from a variety of sources and presents it in a digestible format on a personal computer. To make that information easy to get at, they use the latest in interfaces. Most systems reject



Pilot chairman David Friend says executives want simple interfaces and useful data.

keyboards in favor of a touchscreen, mouse, or infrared controller similar to that for a VCR. A heavy dollop of graphics helps condense data and make it easier to understand at a glance. Users need little training and no manuals.

Such a system opens the vast data store of a mainframe computer to company leaders who know little about computers. Typically, a company programs its EIS so that users can quickly

examine the company's situation in areas of strategic importance. A report displayed on the CEO's computer that marks in red the weaker operations can have a powerful impact on the managers of those operations. The guiding principle is summed up by Pilot founder and chairman David Friend: "That which is monitored, improves."

Executives must have access to the big picture, but they often want more specific information as well. A typical executive information system lets its user go beyond broad brush strokes to spot the details in particularly significant data. To start, an executive might view a table of the company's overall sales, research-and-development expenditures, and net profit. A keystroke or mouse click might then produce the numbers underneath the summary—breaking out sales by product category or by geographic region, for example. Another simple command could peel another layer from the statistical onion, perhaps displaying a month-by-month comparison of a product's actual sales against the budget forecast. This approach, which Pilot chairman Friend calls "drilling down," lies at the heart of most executive information systems.

EIS "doesn't have much [processing]

function," explains Richard L. Crandall, president of Comshare. "It concentrates on packaging and delivery."

Touchscreens offer perhaps the most direct interface. Such a screen lists options as menus, and executives merely put a finger on the appropriate box. Comshare, in particular, touts the advantages of touchscreens. In spring 1987, the company tied its two-year-old System W decision-support software to Easel, a snazzy touchscreen interface from Interactive Images.

Interactive Images also sells Easel separately so customers can build their own in-house systems. Some potential Comshare customers do not want to replace their existing database systems, but are attracted to the eye-catching interface. Nearly 30 percent of Interactive Images' sales this year will wind up in the executive suite, says president R. Douglas Kahn.

Interactive Images' Easel works with either a touchscreen or a mouse, as does Pilot's system, but touchscreens are increasingly the method of choice. "At first, people balk and say they don't want to use touch because the screen will get dirty or their arm will get tired," says Kahn. This reticence dissipates quickly, he says, and about three-quarters of Easel's users now prefer touchscreens (sometimes in conjunction with a mouse).

A third type of interface, used by Execucom's new system, opts for the favorite gadget of VCR and television owners: the infrared remote control.

Some companies, including Comshare, label menu choices with identifying pictures, or icons. Critics belittle the

EXECUTIVE VIEW

Robert W. Scherer

Chairman, CEO, and president, Georgia Power
System: Cadet from Southern Electric International

"The biggest personal benefit Cadet has provided is the ability to view a variety of corporate indicators by one touch of a key. The system lets me create a personal menu with those corporate indicators I need to review on a regular basis. I also have easy access to more than 300 other, more detailed, indicators. As a corporate benefit, Cadet has increased communication throughout the company, reduced cost, and provided the information the executives need in a more efficient and consistent manner."

EXECUTIVE VIEW

Jules Zimmerman

Senior vice president, Avon Products
System: Advantage from Pilot Executive Software

"On a scale of 1 to 10, my computer literacy rates at about two and a half; I learned to type in the Army many years ago. The executive information system helps me look at the numbers behind the numbers, and helps me ask the right questions of the right people. By pushing a few keys, I can zero in on trouble spots—maybe finding out why a division's expenses are higher than projected. I can also get a quick snapshot of our competitors' financial condition—their return on investment, debt ratios, and so forth."



Executive systems package and deliver information, says Comshare president Richard Crandall.

icon approach, however. Pilot originally used icons, but abandoned them when they received a less-than-enthusiastic reception from potential customers. "Executives find the pictures condescending," says chairman Friend. "They can read—and it's usually just as easy to understand a short phrase as it is to decipher an icon." Friend classifies the overuse of icons as "meaningless sex and violence."

EXECUTIVE VIEW

Donald Palmer

Controller, Gillette

System: Advantage from Pilot Executive Software

"I routinely spend at least 10 to 15 minutes every morning using the system to check the latest figures on orders, shipments, and market share, as well as news from outside the company. The computer focuses on exceptions—alerting me, for example, if shipments to customers are taking too long. There's a lot of value just in setting up the system, too. In deciding what areas of performance the system should monitor, we were forced to re-examine our whole business, a useful exercise in itself."

Indeed, Friend's epithet may apply to EIS in general. "It's toys, toys, toys," contends business-graphics maven Allen Paller, director of training and education for the National Computer Graphics Association. "EIS is being sold not to executives, but rather to people who think that this is what they'd like to have when they get to be executives."

Despite the criticism, companies in the EIS market see a bright future for their products. Even though the nature of the product limits its potential user base primarily to the nation's largest companies, suppliers contend that the market is many years from saturation. Only 10 percent of the thousands of senior executives at these organizations have computers on their desks, according to David E. DeLong, a specialist in executive use of computers at MIT's Center for Information Systems Research. Driven largely by the arrival of executive-friendly computers, that figure could rise as high as 70 percent by the mid-1990s, DeLong estimates.

But suppliers such as Pilot and Comshare will have to split the market with large companies who decide to create their own EIS operations. "Right now there are 800 or 900 executive information systems in use," says Paller, "and

only about 100 of them have been bought from outside vendors."

The main hurdle is price. The basic software itself, which runs on the company's existing mainframe computer, costs about \$100,000. But a typical user will spend another \$100,000 to implement the system, much of that for filling the software "shell" with data relevant to the executives who will use the system. Many companies decide that they can do the job themselves for less.

The EIS companies insist they can reverse that trend. "Home-grown EIS is ridiculous," says Pilot's Friend. "All of them will fail, eventually." The extreme user-friendliness that EIS requires is a concept foreign to most corporate computing departments, he says.

But another, possibly more ominous development could turn the tough talk into so much whistling past the graveyard. At least two big companies—Southern Electric and Lincoln National Insurance—have begun marketing commercial versions of their in-house systems.

The more prominent product comes from Southern Electric International. This unregulated arm of Southern Company—the country's largest investor-owned utility—developed the Cadet system for its sister company, Georgia Power. The utility executives embraced the system, and word spread. Finding itself with a potentially significant profit center, Southern Electric last year teamed up with Big Eight accounting firm Arthur Young to sell Cadet to outside customers.

Southern Electric's Cadet differs radically from the Comshare and Pilot sys-

EXECUTIVE VIEW

Jim Creedon

Deputy Director, Arizona Dept. of Transportation

System: Advantage from Pilot Executive Software

"Arizona is building a 230-mile beltway around Phoenix. The computer shows me a map of the road system, with different segments of the highway color-coded to indicate their status. I can click a mouse to get additional information about a particular segment: Is it on budget? Is it on schedule? If not, what's the problem? Anything coded in red means something's not going according to plan. Using the system's electronic-mail capability, I can shoot off a memo to whoever is in charge."

tems. Instead of a mainframe, executives look at information stored on a network of personal computers. More important, Southern Electric sells the Cadet software for about \$25,000, less than one-quarter of what the major EIS products cost. Arthur Young installs the system at the customer's location for \$60,000 to \$90,000, less than half the price of a mainframe-based system.

There's no free lunch, of course, and Cadet's personal-computer-based system can't match the sophisticated business-analysis tools that come with mainframe systems. Southern Electric International settled on this trade-off

after interviewing the executives at Georgia Power. Says Cadet product manager Ron Ferrero, "They did not want 'what-if' analysis tools. They wanted answers."

Arthur Young's Michael Wilkinson explains why the accounting company chose to market Cadet: "The other executive information systems out there are good, and user-friendly, but Cadet is in another league: It's simple." Lincoln National, meanwhile, has yet to find an advocate with the clout of Arthur Young to sell its homemade product.

Now that executive information systems are catching on, general software

companies are looking into creating or adapting products to latch on to the new buzzword. Several companies that make "decision support software"—both spreadsheets and more complex programs that perform business analysis—are adapting their products to appeal to executives. That's a tall order. Top-level people traditionally leave that kind of work to their managers and financial analysts, and thus have little familiarity with decision-support software. "To most executives, Lotus 1-2-3 may as well be Cobol," says International Data's Jastremski.

Nevertheless, companies such as Ex-

WHO'S SELLING EXECUTIVE INFORMATION SYSTEMS

COMPANY	ADDRESS	ANNUAL SALES	NUMBER OF EIS INSTALLATIONS	PRODUCT DESCRIPTION
Comshare	3001 State St. Ann Arbor, MI 48108 (313) 994-4800	\$70 million	80	Commander system combines a user-friendly interface (Interactive Images' Easel) with a decision-support system; gives access to Dow Jones news service; heavy use of icons and graphics; touchscreen interface.
Execucom Systems	Box 9758 Austin, TX 78766 (800) 531-5038	\$20-25 million	Not disclosed	Execucom turns its IFPS decision-support system into an executive tool by combining it with Vantage Point, a userfriendly interface from Forthright Systems.
Forthright Systems	490 Lakeside Dr. Sunnyvale, CA 94086 (408) 730-5700	Not disclosed	Fewer than 20	Vantage Point software lets corporate programmers build their own EIS; uses infrared touchpad, similar to TV remote control.
Forum Systems	5540 Ekwil St. Santa Barbara, CA 93111 (805) 683-5661	About \$2 million	90	PC/Forum offers voice messaging; \$1,000 per user; works with keyboard, mouse, and touchscreen.
Information Resources	Box 9154 Waltham, MA 02254 (617) 890-1100	\$94 million	About 10	Emphasizes easy access to mainframe database through "fourth-generation" computer languages Express and PC-Express; data-analysis tools position product for middle management; uses keyboard, mouse, and touchscreen.
Interactive Images	600 W. Cummings Park Woburn, MA 01801 (617) 938-8440	\$3-5 million	20 to 25	Easel user interface has heavy doses of color graphics; used by Comshare's EIS; touchscreen or mouse interfaces.
Lincoln National Information Service	Box 1110 Fort Wayne, IN 46801 (219) 427-2758	Not disclosed	160	Office Productivity Network, first developed for internal use at Lincoln National Corp.; emphasizes electronic mail, office automation; works only with Prime computers; uses keyboard, mouse, and touchscreen.
Metaphor Computer Systems	1965 Charlestown Rd. Mountain View, CA 94043 (415) 961-3600	\$20 million	112	Metaphor markets workstations and software, targeting "data-dependent professionals" as well as executives; keyboard, mouse, and touchscreen interfaces.
Pilot Executive Software	40 Broad St. Boston, MA 02109 (617) 350-7035	Not disclosed	More than 80	Advantage, a "pure" EIS, with no database management; based on mainframes; uses keyboard and mouse; company has marketing agreement with Digital Equipment.
Southern Electric International	100 Ashford Center N. Atlanta, GA 30338 (404) 392-7626	Not disclosed; \$7 billion for parent Southern Company	11	Cadet system uses network of personal computers; developed for Georgia Power executives; jointly marketed by Arthur Young; low cost; keyboard, mouse, and touchscreen interfaces.

WHAT EXECUTIVE SYSTEMS DO

Executives feed on information—in carefully controlled doses. Traditionally, company chiefs have shied away from computers, which often barrage uninitiated users with more data than they need or can easily digest. Executive information systems (EIS) try to tame this wilderness of facts and figures so it can be used to make effective business decisions.

Advanced software can arrange and display information in easy-to-understand formats for busy executives. To avoid alienating the keyboard-shy, the systems typically use a simple, direct interface such as a touchscreen, mouse, or infrared remote control.

Although their approaches and capabilities vary, many systems share a core group of features:

Exception reporting. Executives usually don't worry about specific operations as long as everything is going according to plan. Therefore, most executive information systems graphically tag areas of the business that are somehow going astray. For example, Comshare's EIS color-codes the numbers it displays: green if they fall within an acceptable range, yellow if the number is near the edge of acceptability, and red if it falls outside that range. The executive sets the threshold of unacceptability—for instance, sales that are more than 10 percent off budget.

"Drill down" capability. Once the system identifies a trouble spot, it can offer successive levels of greater detail. The user merely selects the offending number to bring out the story behind the story. By going down one layer to the regional breakout, the executive might learn that a slumping product is doing well in most of the country but is bombing in New England. Boring in deeper shows that the real trouble lies in lack of promotion—the product exceeded expectations wherever distributors advertised it properly.

Graphic summaries. To help harried executives digest the numbers flowing from a corporate database, an EIS turns them into colorful charts and graphs. Users can drill down through this graphic presentation for the raw numbers.

Electronic mail. Executives gather much of the information they need from subordinates or other executives, often at other company operations. EIS makes it easy to log onto an electronic-mail network, saving time otherwise lost enduring meetings and playing telephone tag.

On-line information service. Some EIS products link to on-line information systems. Comshare's EIS, for example, connects an executive to the Dow Jones News Wire. An EIS also can apply its graphic magic to the outside data.

ecum and Information Resources are sprucing up their decision-support software to appeal to the top rungs of the corporate ladder. Execucum, for example, has added a user-friendly interface to its analysis software, called IFPS (interactive financial planning system). Forthright Systems supplies the new Vantage Point interface under a joint marketing agreement.

Because they offer analytical power as well as ease of use, these modified programs appeal to more than top-rank executives. Their suppliers hope that, once installed in the executive suite, the systems will sweep through the middle-management levels. Everybody, they say, wants access to the same information and analysis their boss gets. "The real market is a layer or two down the organizational chart," says Paul J. De Paul, vice president for marketing at Forthright Systems.

Because the true executive market remains relatively small, analysts doubt that the big computer companies plan to introduce their own EIS products any time soon. IBM, Digital Equipment, Data General, and Wang all sell office-automation networks that have some of the same features of executive information systems. But these prod-

ucts emphasize intracompany messaging and scheduling, not executive-level overviews. Comshare and Pilot each have invested tens of millions of dollars in their systems; IBM's most logical move, some argue, would be to buy an EIS company rather than spend its time reinventing the wheel.

Digital has entered the EIS business indirectly, by making Pilot a cooperative marketing partner. "It's their seal of approval," boasts Friend. Under the arrangement, the Pilot system will be installed and demonstrated in all of Digital's showrooms.

If homegrown software, decision-support software, and the computer giants pose market threats to the fledgling industry, a technology challenge also lurks in the form of Apple Computer's HyperCard, introduced last year, and Lotus' Agenda, geared to IBM-compatible computers. These information-management systems let people roam around huge databases that contain information set up like stacks of index cards. Relatively simple programming instructions link any card in the stack to any other card.

Such systems could perform many EIS functions. For example, in Hypercard, a card describing a company em-

ployee could be linked to various other cards. The user could click the mouse to reveal such information as an organizational chart showing that employee's rank, a resume or biography, a picture, or a summary of each project the worker has been involved with.

One stack of cards could pertain to a company's product line. The top card would describe the line in general terms. One mouse click could unveil a detailed diagram showing how the product works. Another might display a list of competing products; a third click could produce a screenful of pictures detailing the manufacturing process.

Such software puts a new spin on the EIS business, says Paller of the National Computer Graphics Association. He predicts that a flurry of new entrants into the field will attempt to break the market wide open with Hypercard-based systems that cost a fraction of what current EIS implementations do. The present EIS champions—Comshare and Pilot Executive Software—might not be able to take advantage of the new technology for fear of cannibalizing their existing product lines.

"What's been missing in EIS," says Paller, "is a \$25,000 solution. Now we may see that." ■

Presidential Adviser William Graham

ON GOVERNMENT SPENDING

THE UNITED STATES government is the prime mover behind much of the most advanced technology emerging today. The billions it spends on research, development, and products probably make it the largest technology consumer in the world.

As President Reagan's science adviser since 1986, William R. Graham has a significant voice in the country's technology decisions. Graham, age 50, is also director of the Office of Science and Technology Policy. These duties give him unique insight into the Oval Office's viewpoint on developments in the Defense Department, NASA, the Department of Energy, and elsewhere.

Recent issues of *HIGH TECHNOLOGY BUSINESS* have looked at many of the technology projects supported by the federal government—the space station, the Strategic Defense Initiative, superconducting, and the National Aerospace Plane. Assistant managing editor Jeffrey Zygmunt asked Graham about the business opportunities the nation can expect from these and other technology programs.

■ *HT Business: What's the federal government doing about superconductivity?*

GRAHAM: The President has put out an 11-point program. We'll be following that shortly with proposed legislation and a report by the White House Science Council

William R. Graham

Born: June 15, 1937

Responsibilities:

To advise the president on science, technology, and engineering issues; to help formulate plans, policies, and programs

1987 R&D budget:
\$65 billion





GREG PEASE

calling for further activity, including the formation of centers and several national laboratories, as well as a substantial Defense Department research program in high-temperature superconductivity.

One of the government's most important roles is to act as a catalyst—to make sure that industry understands that, in today's highly competitive international environment, it is essential that we pursue technologies before they are fully developed in the laboratories of our competitors. Other countries have been striving to catch up with the United States, as they recovered from the destruction of World War II. They had to move into advanced technology at a pace that was faster than ours. Several of these countries have caught up with us, and are now accustomed to innovating and advancing technology more rapidly than we are.

■ *HT Business: Is the government's interest in superconductivity related to defense?*

GRAHAM: We depend on advanced technology to provide for our national defense. In that sense, any advanced technology can be quite important. But even if there were no defense applications for high-temperature superconductors, we would still be pressing very hard. The government strongly supports basic research in underlying, enabling technologies. In 1988, we plan to spend \$9 billion on basic research.

At the same time, in the president's view, and I agree with him, the government has no place in conducting research to develop products. The government has no skill or incentive in that business. Far better for the private sector to take the initiative in that area.

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**“It is essential that we
pursue technologies
before they are developed
in the laboratories of our
competitors.”**

■

■ *HT Business: How effectively is basic, government-funded research finding its way into commercial products in the private sector?*

GRAHAM: I would say that government by and large has done poorly in the past, is improving today, and can still do much better in the future.

We always knew that spin-offs from space programs were valuable, but I don't think we have focused strongly on pressing that process. This applies not just to the space and defense programs, but also to basic research.

We're taking a number of innovative steps to try to increase the technical transfer from basic government-sponsored research to product development and production in industry. For example, we're allowing researchers in government laboratories to license proprietary discoveries; thus, both the laboratory and the researcher derive some benefit from the license. At the same time, by giving companies exclusive licenses, we're giving them the protection they need to pursue proprietary developments.

In many ways, a discovery that is everyone's intellectual property is no one's intellectual property. Not many industries are going to put \$50 million into a basic technology if they know a competitor can take advantage of their work. Therefore, exclusive licensing is one of the measures that has been incorporated into the technology-transfer acts of 1986 and the executive order facilitating technical transfer.

Another dimension to encouraging technology spin-offs is the engineering research centers we are establishing at various universities around the country. These are interdisciplinary centers that draw substantial support from industry and, on occasion, from government laboratories as well.

■ *HT Business: The Strategic Defense Initiative has been the subject of heated political debate. Do you think the program will survive beyond the Reagan administration?*

GRAHAM: After more than three years of assimilation in this country, I think there is a widespread consensus that research on strategic defense is very valuable and important. The issue has shifted more toward determining when we should move to developmental programs focused on various stages of deployment.

I think it's quite important that we move toward deployment because, first, the Russians are moving aggressively in this area and already have an operational system deployed in the Moscow area. Also, as we move aggressively toward deployment, it will add the discipline that can only come from moving toward specific goals and practical implementations.

■ *HT Business: So you think the program is on firm political footing?*

GRAHAM: I think there is still a major effort in some quarters of Congress to treat SDI not as a national security issue but as a political issue, and to underfund the program seriously. If that is allowed to continue, it will have very detrimental effects on our overall strategic defense capability in the next few years.

■ *HT Business: Has the administration made any plans concerning deployment?*

GRAHAM: Not quite. SDI has been almost entirely a research program. It's important we continue this. But in addition to that, it is important that we initiate a development program addressing specific system concepts such as architectures, capabilities, effectiveness, and so on, to make sure our research is moving in the correct direction.

■ *HT Business: Do you think development will begin before the end of this administration?*

GRAHAM: If Congress provides the funding the president requests.

■ *HT Business: It's been two years since the Challenger disaster. How is the space program doing?*

GRAHAM: I think the space program is making progress now. As somebody said, half in jest, 10 years from now we're going to be up to where we were 10 years ago. The problem isn't in our technical preeminence. It's in our long-term vision, our planning and our ability to look beyond the next spectacular event to see where we want to go in space over the decades. We have to lay out a general plan that isn't focused on a single objective but rather has a broad range of goals, including better understanding of the earth and its environment, exploration of the solar system, and beyond.

We made a very unwise move when we narrowed the base of our space program down to the shuttle and little else. When you restrict a program to a knothole, and the knothole goes away for a time, it is very painful.

■

"We made a very unwise move when we narrowed the base of our space program down to the shuttle."

■

■ *HT Business: What's being done to broaden the space program?*

GRAHAM: We are bringing the shuttle system back into operation. We are also very aggressively moving into production of the Titan Four medium extendable launch vehicle, and the Delta rocket derivative from McDonnell Douglas. We're looking for another intermediate-capability launch vehicle, and we're looking to the future for heavy-lift capability. Such a rocket could be operated at considerably less cost than current systems, because it would use more advanced technology focused on the recurring, operational cost rather than just the development cost.

■ *HT Business: When will we see these new vehicles?*

GRAHAM: We'll see the next Titan go up sometime this year. I think we'll be converting to Titan Four production before the end of the decade, and also we'll have the medium extendable launch vehicles coming out in the next couple of years, because they're related to an existing system. The shuttle will be flying next summer, we hope. So before the end of the decade, we'll see a family of booster rockets available to both the government and private sector for access to space. It's a good thing, because our backlog of payload waiting to be launched into space is escalating acutely. It is going to take a while to work off all that backlog, using all the production we can generate from the boosters.

■ *HT Business: Some space advocates feel the space-station program has been compromised by penny pinchers in Congress. Do you think the program goes far enough?*

GRAHAM: I don't think Congress has been anything less than generous with the space station. The budget history of the space station has not been very smooth, and it's clear that we need further management control to carry out the program. NASA is making a substantial effort to provide that. The National Research Council pointed out that Phase I of the program seemed justified, but Phase II [which is not yet funded] appeared to be premature. To NASA's credit, it separated the two parts and proposed funding for the first phase. When you finally get down to counting the votes, Congress has been very supportive of the space-station program, the aerospace-plane program, and other impressive technological initiatives.

■ *HT Business: You mentioned the National Aerospace Plane. Is there anything to the talk of developing commercial airliners based on this research program?*

GRAHAM: We're looking at airplanes that operate at 100,000 feet or above to get rid of the sonic-boom problem, and that operate at substantially higher speeds—Mach 6. That would provide flight efficiency that we really can't obtain today. We hope to have something by around the end of the century. We're still in the early technological stages, but I can tell you that all signs look good.

■ *HT Business: There is still talk of possible energy shortages in the United States. What do you see as the medium- to long-term energy outlook?*

GRAHAM: The Department of Energy completed a study on energy and energy security recently. It says basically that we should become less vulnerable to any possible foreign interruption of our oil supply by using the national petroleum reserves. At the same time, we should encourage the U.S. private sector to move aggressively in extending our own energy resources.

In the longer run, we all know that fossil fuel is a nonrenewable energy source, and that its by-products have a potentially hazardous effect on the atmosphere. We're going to have to find a reliable, environmentally sound antidote. One is very safe nuclear power. In the long run, we hope nuclear fusion will be successful.

■ *HT Business: Will public sentiment ever turn in favor of nuclear power?*

GRAHAM: There is strong public support for nuclear fusion power sources. I think there is a concern over nuclear fission, although I think that concern is considerably overstated.

But public sentiment has to be taken into account. It is important to have a technically literate public, to understand the substance of the issues before us—reactor safety, and fossil-fuel problems like carbon dioxide, climate effects, and many other issues.

We all pay a terrible price for technological illiteracy in this society, and far too many of us are technologically ill-informed. One of the most important things that government at all levels must do is strengthen our technical literacy, our education. I think it equally important for every citizen to realize how important it is to be knowledgeable and well-informed, whatever the topic.

■

GET THE EDGE

In case you missed any of these stories when they appeared in HIGH TECHNOLOGY BUSINESS, here is a selected listing from the past year. Check the stories you want and fill in the form. Include \$5 for each story to cover photocopying, postage, and handling.

COMPANY PROFILES

- ☐ 3-D Systems
- ☐ Aian
- ☐ Alcoa
- ☐ Aspect Telecommunications
- ☐ AT&T
- ☐ Cheyenne Software
- ☐ Clinitherm
- ☐ CMQ
- ☐ Cypress Semiconductor
- ☐ Digital Equipment
- ☐ Endogen
- ☐ Flow Systems
- ☐ GM
- ☐ GTX
- ☐ Healthdyne
- ☐ Interactive Medical Communications
- ☐ LISSA
- ☐ Management Science America
- ☐ Mathssoft
- ☐ Mentor Graphics
- ☐ Microvideo Learning Systems
- ☐ Odetics
- ☐ Optex Biomedical
- ☐ Petrafem
- ☐ Precision Robots
- ☐ Prime
- ☐ TRW
- ☐ Vayager
- ☐ Xerox

COMPUTERS

- ☐ A Rise in No-Fault Systems
- ☐ CAD/CAM's \$800-Million Winners
- ☐ Chip Takeover Targets
- ☐ Design With People in Mind
- ☐ Desktop Publishing Comes of Age
- ☐ Filling in Word-Processing Gaps
- ☐ 'Look and Feel' Lawsuits
- ☐ Office Standards Relax
- ☐ The Desktop Publishing Fad
- ☐ The Language Advantage
- ☐ The Newest Microcomputers: Strategies For Macintosh Owners
- ☐ The Newest Microcomputers: What Should You Do Now?

- ☐ The Return of Outside Data Processing
- ☐ Rethinking the Mainframe
- ☐ Survival Strategies: Chip Companies Shift Gears
- ☐ Workstation Wars: Battle of the Big 7
- ☐ Writable Optical Disks for Personal Computing

CONSUMER

- ☐ Camcorder Companies Divvy Up a Bewildered Market
- ☐ Home, Safe, Home
- ☐ Interactive TV Opens New Retail Market
- ☐ Money Machines Outgrow Banking
- ☐ More Schooling for Tomorrow's Engineers?
- ☐ Office Aids for Executives
- ☐ Patents Vs. Public Interest
- ☐ Revolution in Toyland
- ☐ Smart Cards Get Smarter
- ☐ The Big Screen Comes Home
- ☐ The Startup Insurance Trap

INDUSTRIAL

- ☐ 1988's Hottest Superconducting Companies
- ☐ Alternate Fuels Edge Into Auto Markets
- ☐ Assembly Lines Build Ideas
- ☐ Big Hopes For Small Dishes
- ☐ Chemistry's New Workhorse
- ☐ Companies Cash In on Soviet Technology
- ☐ Companies Turn Ideas Into Profits
- ☐ Competitors Team Up
- ☐ Data Access Cost May Rise
- ☐ Dawn of the Biotech Farm
- ☐ The Superconducting Sprint
- ☐ France Plays Catch-up in Biotech Market
- ☐ Laser Radar Comes Out of the Lab
- ☐ Network Vendors Wage Price Wars
- ☐ New Filters Clean Up in New Markets
- ☐ New Uses for Digital Tape
- ☐ New Water System Cuts Filtering Cost
- ☐ Optical Memories Vie for Data Storage
- ☐ Phone Companies Argue Over New Standards
- ☐ Phone Companies Gamble on Technology
- ☐ Picking the Next Standard

- ☐ Prefab Houses Move Upscale
- ☐ Scanner Standards: Who Will Emerge?
- ☐ Superconductor Race Accelerates
- ☐ Superconducting: The New Billion-Dollar Business
- ☐ U.S. Robot Makers Try to Bounce Back

INVESTMENTS

- ☐ Application-Specific Chips Find Widening Use
- ☐ Biotech Instrumentation: A Profitable Niche
- ☐ Investing the High-Tech Way
- ☐ Machine Vision Broadens Its Horizon
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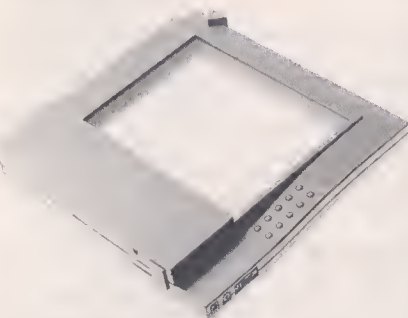
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PC Viewer transparency viewers. These liquid-crystal-display viewers rest on an overhead projector and plug into Apple Macintoshes, Apple IIs, IBM PS/2s, or IBM PC and compatible computers. Four models either store text and graphics developed on the computer, or display material directly from the computer. \$895 to \$2,495. In Focus Systems Inc., 7997 S.W. Mohawk St., Tualatin, OR 97062. (503) 692-4968. *Circle 1.*

Async/APPC communications software. Lets an IBM PS/2 or PC use its serial port to communicate with another PS/2 or PC using IBM's Logical Unit Type 6.2 protocol. \$285. Network Software Associates Inc., 22982 Mill Creek, Laguna Hills, CA 92653. (714) 768-4013. *Circle 2.*

AST-VGA graphics board. Made for business graphics, CAD/CAM, and desktop publishing; offers 640×480-pixel resolution and a choice of 16 colors from a palette of 262,144. The half-size board goes in IBM PC/XT/AT and compatible computers and works with EGA, CGA, HGC, and MDA graphics standards. \$495. AST Research Inc., 2121 Alton Ave., Irvine, CA 92714. (714) 863-1333. *Circle 3.*

EZ-Fax PC facsimile adapter. This card equips IBM-compatible computers to send and receive facsimiles while in use. Options include a 1200-bit/second, Hayes-compatible modem board and a DES encryption chip. \$1,495. GMS, 1065 S. Rogers Circle, Boca Raton, FL 33487. (800) 443-0500; in Fla., (305) 994-6500. *Circle 4.*

MDA-4 message machine. Answers the phone with a recorded message on as many as four incoming CO or PBX lines. \$790. Viking Electronics Inc., Box 448, Hudson, WI 54016. (715) 386-8861. *Circle 5.*

Merge System A modem. Handles voice and data communications alternately over one phone line. Can work without a computer, storing 128 pages of text in its own memory. Hayes-compatible; meets Bell 212A and V.22 standards. From \$399. New Generation Technology, 16742 Gothard St., Suite 217, Huntington Beach, CA 92647. (800) 426-3743; in Calif., (714) 848-0871. *Circle 6.*

MicroNetwork Auditor station. A computer terminal for networks. It performs security and data-auditing functions. For Novell, PC Net, Alloy, or Corvus networks. \$12,750. Absolute Security, Box 399, Maynard, MA 01754. (617) 897-1991. *Circle 7.*

Platinum Card graphics board. Adds VGA graphics to IBM PC/XT, PC Portable, Compaq PC Portable, and compatible computers. The board offers 800×560-pixel resolution and supports Windows, Gem, Ventura Publisher, PageMaker, Lotus 1-2-3, Symphony, and AutoCad software. \$449. Tatung Company of America Inc., 2850 El Presidio St., Long Beach, CA 90810. (213) 979-7055. *Circle 8.*

PrintDirector printer networks. Model MS-1 has four serial and four parallel ports to link eight personal computers to a printer. Model MS-10 has 10 ports, all serial or four parallel and six serial. \$1,195 and \$1,395. Digital Products Inc., 108 Water St., Watertown, MA 02172. (617) 924-1680. *Circle 9.*

PromiseLAN network. This two-card local-area network connects 17 IBM-compatible personal computers. Data transfers occur at one million bits/second. \$375 for a two-computer configuration; \$150 for each additional adapter. Moses Computers, 15466 Los Gatos Blvd., Suites 109-137, Los Gatos, CA 95032. (408) 370-7979. *Circle 10.*

TeleDesk phone console. This Centrex station reduces the number of keystrokes needed to handle calls. It works with IBM-compatible computers to handle a company directory and message center. \$8,500. Conveyant Systems Inc., 2852 Alton Ave., Irvine, CA 92714. *Circle 11.*

ViaNet Professional network. A local-area network for IBM-compatible computers, including the PS/2. Uses standard IBM commands and protocols; a menu-driven installation program helps add or remove nodes without interrupting the network.

\$150/node. Western Digital Corp., 2445 McCabe Way, Irvine, CA 92714. (714) 863-0102. *Circle 12.*

■ COMPUTER HARDWARE

7396 Personal System workstation. This IBM-compatible, 80386-based station runs at 20 or 16 megahertz and supports DOS 3.3 and OS/2. It works alone or in a coaxial or twinaxial network. Includes two megabytes of random-access memory, plus two 8-bit and three 16-bit expansion slots. Price not available. Memorex Corp., 611 South Milpitas Blvd., Milpitas, CA 95035. (408) 957-1000. *Circle 13.*

Acer desktop publisher. System includes an 80286-based computer, a 12-inch monochrome monitor, software, and a laser printer that produces six pages/minute. \$5,595. Acer Technologies, 401 Charcot Ave., San Jose, CA 95131. (408) 922-0333. *Circle 14.*

Audio/Video/Mouse board. Provides monochrome or color graphics with 640×200-pixel resolution from one video port. Has a Microsoft-compatible mouse port and two-channel music/voice synthesizers. A half-size card for the IBM PC/XT/AT and compatible computers. \$395. Electro Design Inc., 690 Rancheros Dr., San Marcos, CA 92069. (619) 471-0680. *Circle 15.*

Avatex 2400MNP modem. Compresses data to send 4,800 bits/second; includes Microcom's MNP Level 5 error-control protocol. \$429. Elec & Eltek Corp., 1230 Oakmead Pkwy., Suite 310, Sunnyvale, CA 94086. (408) 732-1181. *Circle 16.*

Black Box security device. This call-back controller installs between a modem and a telecommunications interface to prevent unauthorized telephone access to a serial computer. Uses programmed access codes and phone numbers. \$450 for a one-line unit; \$695 for two lines. Black Box, Box 12800, Pittsburgh, PA 15241. (412) 746-5500. *Circle 17.*

Genius² monitor. This 19-inch display lets microcomputer users view two pages of text and graphics in white-on-black or black-on-white. Has 100 dot/inch resolution. \$2,495. Micro Display Systems, Box 455, Hastings,

MN 55033. (800) 328-9524; in Minn., (612) 437-2233. *Circle 18.*

Inboard 386/PC computer booster. This 80386-based board enhances the IBM PC/XT and compatible computers. It has one megabyte of 32-bit memory and two software utilities to increase display speed and hard-disk performance. \$995. Intel Corp., M.S. C03-07, 5200 N.E. Elam Young Pkwy., Hillsboro, OR 97124. (503) 629-7354. *Circle 19.*

LaserBank 800 optical drive. Adds 800 megabytes of storage to write-once, read-many (WORM) optical disks. Works with the IBM PC/XT/AT, PS/2, and compatible computers with 384 kilobytes of memory. \$9,995. Micro Design International Inc., 6985 University Blvd., Winter Park, FL 32792. (800) 228-0891; in Fla., (305) 677-8333. *Circle 20.*

LQ-500 printer. This 24-pin, 80-column printer includes text and graphics modes and a parallel interface. Prints 180 characters/second in draft, 60 characters/second in letter quality. \$499. Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505. (800) 421-5426; in Calif., (213) 539-9140. *Circle 21.*

PC Remodeling kits. Upgrades IBM PCs into XT or AT models. Includes backplane,

memory board, XT or AT processor board, and wiring harness. Options include an AT power supply and keyboard choices. From \$398. Innovation Computer Corp., 1325 Juniper St., Cleveland, WI 53015. (414) 693-3416. *Circle 22.*

MST Replica disk copier. Automatically duplicates 3½-, 5¼-, and 8-inch double-sided disks; makes 300 copies/hour. Various models support MS-DOS, Apple Macintosh, Atari, DEC, Wang, and Commodore Amiga formats. From less than \$10,000. Media Systems Technology Inc., 16812 Hale Ave., Irvine, CA 92714. (714) 863-1201. *Circle 23.*

Multisync Plus monitor. A flat, 15-inch screen for the IBM PC/XT/AT, PS/2, and Apple Macintosh II. Resolution reaches 960×720 pixels. The screen synchronizes horizontal and vertical scan rates, and displays unlimited colors with an analog signal. \$1,395. NEC Home Electronics Inc., 1255 Michael Dr., Wood Dale, IL 60191. (312) 860-9500. *Circle 24.*

Network PC 386 computer. This diskless personal computer offers one megabyte of random-access memory and a 16-kilobyte cache. Has serial and parallel ports, and three expansion slots. \$3,299 to \$3,499. Con-

vergent Technologies, 2700 N. First St., San Jose, CA 95134. (408) 434-2848. *Circle 25.*

Rival 286 personal computer. Built around an 80286 processor, with 640 kilobytes of random-access memory that expands to 16 megabytes. Includes six 16-bit and two 8-bit expansion slots, one parallel and two serial ports, a 5¼-inch floppy-disk drive, and a 14-inch amber monitor. \$1,795. Arche Technologies Inc., 745 High St., Westwood, MA 02090. (800) 422-4674; in Mass., (617) 461-1111. *Circle 26.*

STM 5100 laptop computer. This IBM PC/AT-compatible computer has a 20-megabyte hard disk, a 3½-inch disk drive, and a gas-plasma screen. Includes one megabyte of random-access memory, plus one parallel and one serial port. Weighs 15 pounds. \$3,195. Samsung, 3725 N. First St., San Jose, CA 95134. (408) 434-5400. *Circle 27.*

System IV laptop computer. Works with MS-DOS computers; ready to handle MS-DOS/2 when available. Has a 20-megabyte hard disk, a 3½-inch disk drive, a gas-plasma screen, 640 kilobytes of random-access memory, two RS-232C ports, and a parallel port. Weighs 14 pounds. \$4,395. Ogivar Technologies, 7200 Trans Canada Hwy.,

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Display Font Pack headlines. Provides headline typefaces for Ventura Publisher and Aldus PageMaker desktop publishing software. Requires a CGA, EGA, VGA, or Hercules display. \$95. SoftCraft Inc., 16 N. Carroll St., Madison, WI 53703. (800) 351-0500; in Wis., (608) 257-3300. *Circle 31.*

Gofer file finder. Works with word-processing programs; opens and searches through files that have not been indexed, reducing retrieval time. Runs on IBM PC, PS/2, and compatible computers. \$79.95. Microlytics Inc., 300 Main St., East Rochester, NY 14445. (800) 828-6293; in N.Y., (716) 248-9150. *Circle 32.*

Graphwriter II chart maker. Produces and updates charts created from spreadsheet or database data. Needs an IBM PC/XT/AT, PS/2, or compatible computer with 512 kilobytes of memory, a hard disk, and a graphics board. \$495. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142. (800) 345-1043; in Mass., (617) 577-8500. *Circle 33.*

Help System tutor. A help program that eases the transition from WordStar to WordPerfect word-processing programs. \$95. Imsatt Corp., 500 N. Washington St., Suite 101, Falls Church, VA 22046. (703) 533-7500. *Circle 34.*

ImageStudio paint program. This Macintosh-based image processor retouches scanned images and stores them in standard formats for use in software programs. \$395. Letraset USA, 40 Eisenhower Dr., Paramus, NJ 07653. (800) 631-1603; in N.J., (201) 845-6100. *Circle 35.*

List Plus database manager. Runs on the Apple IIGS to create and manipulate databases. Uses mouse and pull-down menus; requires 768-kilobyte memory. \$99.95. Ac-

tivision Inc., Box 7286, Mountain View, CA 94039. (415) 960-0410. *Circle 36.*

Magic Mirror data exchanger. Captures data from a computer screen and transfers it to another program. For IBM-compatible computers with 256 kilobytes of memory, running DOS 2.0 or higher. \$89.95. SoftLogic Solutions Inc., 1 Perimeter Rd., Manchester, NH 03103. (800) 272-9900; in N.H., (603) 627-9900. *Circle 37.*

Memory Lane searcher. Finds any word, number, or change on the hard disk of an IBM-compatible computer. Lets users search for items in dBase while running WordPerfect, or move information among word-processing programs. \$99. Group L, 481 Carlisle Dr., Herndon, VA 22070. (800) 672-5300; in Va., (703) 471-0030. *Circle 38.*

Spellbinder art library. Offers more than 50 cartoon characters, including political figures and animals. For desktop publishing on an IBM PC. \$79. Lexisoft, Box 1950, Davis, CA 95617. (916) 758-3630. *Circle 39.*

Timeslips 3.1 billing system. Keeps track of time and generates bills for law, accounting, or consulting firms. Handles as many as 30 employees; runs on the IBM PC/XT/AT, PS/2, or compatible computers with 384

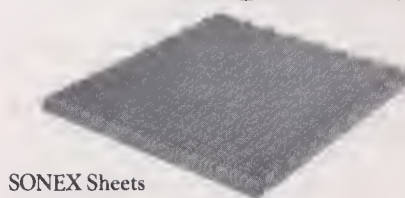
kilobytes of memory and a hard disk. \$199.95. North Edge Software Corp., 239 Western Ave., Essex, MA 01929. (617) 468-7358. *Circle 40.*

Tops/Sun Workstation file server. Connects Unix-based Sun workstations to Apple Macintoshes, IBM PCs, and compatible computers running Tops' distributed file-server network. Provides transparent access to large-capacity disk storage. \$895 to \$2,495. Tops, 2560 Ninth St., Berkeley, CA 94710. (415) 549-5900. *Circle 41.*

Wall Street Investor portfolio manager. Made for individual investors, Version 2.0 stores records of securities and transactions and generates portfolio reports. Offers access to more than 17,000 stocks, options, mutual funds, and bonds; includes fundamental analysis. \$495. Pro Plus Software Inc., 2150 E. Brown Rd., Mesa, AZ 85203. (602) 461-3296. *Circle 42.*

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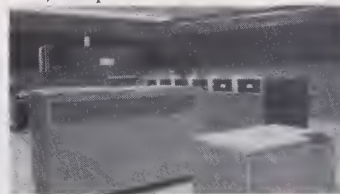


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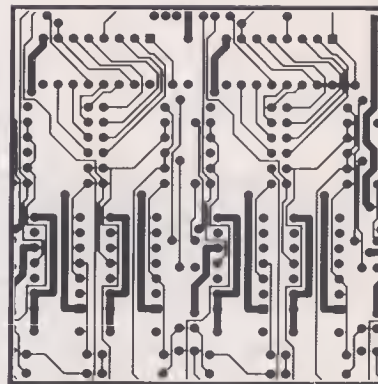
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371 curve tracer. A programmable tester that generates 400 amps to stimulate semiconductor devices and display, measure, and store their response. \$19,450. Tektronix Inc., Box 1700, Beaverton, OR 97075. (800) 547-1512; in Ore., (800) 542-1877. *Circle 45.*

3021 accelerometer. A tiny silicon sensor that monitors acceleration, vibration, and shock. Measures 7.9×7.3 millimeters. From \$87 each for samples. IC Sensors Inc., 1701 McCarthy Blvd., Milpitas, CA 95035. (408) 432-1800. *Circle 46.*

AF/Lifejacket software. Automatically intercepts, diagnoses, and repairs most common causes of computer failures in an IBM-mainframe CICS environment. Handles storage violations, runaway transactions, bad system codes. \$32,000 for XA environments, \$16,000 for non-XA. Candle Corp., 1999 Bundy Dr., Los Angeles, CA 90025. (213) 207-1400. *Circle 47.*

Cimplex NCV software. For CAD/CIM operations, this program simulates motions specified by a controller to verify the accuracy of the machining process. Runs on Silicon Graphics' Iris workstations. Rents from \$4,200/month. Automation Technology Products, 1671 Dell Ave., Campbell, CA 95008. (408) 370-4000. *Circle 48.*

CX Workstation publishing system. Creates and paginates documentation and lays out publications as large as newspapers. Helps design correspondence, forms, brochures, and print ads. A 15-inch monitor permits image manipulation; the system includes a laser printer. \$9,865. Publishing

Empire, Box 13250, Sacramento, CA 95813. (916) 646-1111. *Circle 49.*

Eagle 6050 scanner. Scans documents as wide as 64 inches with variable resolution as tight as 1,000 lines/inch. Covers 5.7 inches/minute; handles paper, mylar, vellum, or film. \$90,000. ANA Tech Corp., 10499 Bradford Rd., Littleton, CO 80127. (303) 973-6722. *Circle 50.*

FTP thermal printers. Two models print 250 dot lines/second with a resolution of 160 dots/inch. Front and rear paper loading allows printing on different media, including thick paper or labels. \$198 for the 40-column FTP-421MCL001; \$258 for the 80-column FTP-441MCL001. Fujitsu Component of America Inc., 3320 Scott Blvd., Santa Clara, CA 95054. (408) 562-1000. *Circle 51.*

HDS3200 terminals. These DEC-compatible terminals integrate text and graphics and offer a 15-inch monitor with amber, green, or page-white display. From \$699. Human Designed Systems Inc., 3440 Market St., Philadelphia, PA 19104. (215) 382-5000. *Circle 52.*

HP8145A reflectometer. This optical time-domain reflectometer checks optical fibers and cables during design or production. A plug-in, nonvolatile memory stores more than 100 traces. \$23,990 to \$34,990. Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, CA 94304. Call local sales office. *Circle 53.*

KB670, KB675 keyboards. Flexible-membrane, ASCII-encoded keyboards that withstand harsh environments. The KB670 has 58 keys; the KB675 adds a 16-key number pad. Both models connect to computers through a built-in 20-pin parallel port or a 25-pin serial port. \$199 and \$239. Cardinal Technologies Inc., New Holland Ave., Lancaster, PA 17604. (800) 722-0094; in Pa., (717) 295-6922. *Circle 54.*

Model 5050 hard-disk subsystem. This system holds 500 megabytes for Hewlett-Packard computers; fits on an H-P minirack. \$12,500. Bering Industries Inc., 280 Technology Circle, Scotts Valley, CA 95066. (408) 438-8779. *Circle 55.*

MS-4032 CCD camera. When triggered by movement, this camera captures images from transient events. \$3,695. Sierra Scientific, 1173 Borregas Ave., Sunnyvale, CA 94089. (408) 745-1500. *Circle 56.*

MVME393 graphics controller. This board supports eight color monitors, handling multiple screens of text and graphics for such tasks as flight simulation, factory automation, financial-transaction processing, and navigation. \$3,295. Motorola, Microcomputer Division, 2900 S. Diablo Way, Tempe, AZ 85282. (800) 556-1234; in Calif., (800) 441-2345. *Circle 57.*

PC-385/302 bar-code readers. The PC-385 works with the Macintosh II, SE and Apple IIGS computers to process data from bar-code labels; the PC-302 works with the IBM PS/2. \$795 each. TPS Electronics, 4047 Transport St., Palo Alto, CA 94303. (415) 856-6833. *Circle 58.*

Pro/Engineer modeling system. Handles parametric solids modeling; allows fast, interactive changes of complex models. \$9,500. Parametric Technology Corp., 128 Technology Dr., Waltham, MA 02154. (617) 894-7111. *Circle 59.*

PTC-620 bar-code scanner. This handheld device has an alphanumeric keyboard and uses algorithms to reduce errors. \$995. Telxon Corp., 3330 W. Market St., Akron, OH 44313. (800) 321-2424; in Ohio, (800) 222-3330. *Circle 60.*

QLC-1000 optical-disk controller. Transfers data at 250 kilobytes/second for DEC systems. Works with 5¼- and 12-inch write-once, read-many (WORM) optical disks. \$1,995. Qualogy Inc., 2241 Lundy Ave., San Jose, CA 95131. (408) 434-5200. *Circle 61.*

RX7100/7200/7400 printers. Model RX7100 prints five pages/minute and handles 3,000 pages/month from one computer. The RX7200 prints 12 pages/minute, 10,000 pages/month, also from one computer. The RX7400 prints 22 pages/minute, 25,000 to 50,000 pages/month, and can be linked to multiple computers. All three models have 300×300-dot/inch resolution. \$1,160, \$2,110, and \$6,380 each in lots of 100. Fujitsu America Inc., Computer Products Group, 3055 Orchard Dr., San Jose, CA 95134. (408) 432-1300. *Circle 62.*

Series F3 force sticks. These computer-input devices use semiconductor strain-gauges to sense force applied by the fingertips for accurate, rapid response. The sticks plug into RS-232C serial ports for controlling 2-D and 3-D interactive graphics. \$765 for the two-axis model; \$965 for a four-axis version. Tactron Scientific Inc., 7265 Mountain Trail, Dayton, OH 45459. (513) 434-4117. *Circle 63.*

TableMaster typesetting software. Helps convert word-processor and spreadsheet tables into typeset tables suitable for publication. \$750. Bestinfo Inc., 1400 N. Providence Rd., Media, PA 19063. (215) 891-6500. *Circle 64.*

Targon System 35/50 computer. This supermicro computer runs under Unix and offers a relational database and a fourth-generation applications builder. Has 4 to 64 megabytes of random-access memory; accommodates 191 terminals. \$125,000 to \$175,000. Nixdorf Computer Corp., 80 Main St., North Reading, MA 01864. (617) 664-5781. *Circle 65.*

■ MANUFACTURING SUPPLIES

Accumistor thermistors. Various models provide precision heating, offer overcurrent protection, and sense temperature, liquid level, and flow. Operating temperatures span -40 to 220 degrees Celsius. \$5 each in lots of 10,000. Elmwood Sensors Inc., 500 Narragansett Park Dr., Pawtucket, RI 02861. (401) 727-1300. *Circle 66.*

D-subminiature connectors. These mass-terminated, flat-cable devices have beryllium-copper contacts and tin or zinc-chromate plating. They come with 9, 15, 25, or 37 positions. \$1.44 to \$4.47 each in lots of 1,000. TRW, Electronic Components Group, 1501 Morse Ave., Elk Grove Village, IL 60007. (312) 981-6000. *Circle 67.*

DK711S Winchester drive. Transfers data at 2.46 megabytes/second; holds 600 megabytes of unformatted data. The drive has 13 5¼-inch platters with 22 data heads and includes an Enhanced SMD interface. \$5,500 each in large quantities. Hitachi America Ltd., 950 Elm Ave., San Bruno, CA 94066. (415) 872-1902. *Circle 68.*

MN6290/6291 converters. 16-bit sam-

pling, analog-to-digital converters made for digital-signal-processing applications. Internal track-hold amplifiers allow 20 kilohertz operation. \$180 to \$270 each in lots of 100. Micro Networks/Unitrode, 324 Clark St., Worcester, MA 01606. (617) 852-5400. *Circle 69.*

■ CONSUMER PRODUCTS

8701RT ETR car radio/tape deck. This AM/FM stereo cassette unit has electronic tuning for drift-free reception; it automatically reacts to FM-signal changes. \$299.95. Clarion Corp. of America, 5500 Rosecrans Ave., Lawndale, CA 90260. (213) 973-1100. *Circle 70.*

BlackJack Master software. Plays the card game blackjack according to various casino rules. Includes a practice mode that provides coaching to improve skills. The program also simulates play at 24,000 hands/hour to let users test playing strategies. \$49.95. Elite Inc., 201 Penn Center Blvd., Pittsburgh, PA 15235. (412) 829-7770. *Circle 71.*

ClearVoice hands-free cellular phone. Offers clear voice-transmission and hands-free operation; attaches to a car's seat-belt shoulder strap. \$199. Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60202. (312) 866-2553. *Circle 72.*

DataSoft computer games. Two strategy games. The first, Bismarck, simulates the 1941 sea battle between HMS Hood and the German ship Bismarck. The second, Force 7, lets players control a team battling aliens in outer space. \$29.95 and \$19.95. Electronic Arts, 182 Gateway Dr., San Mateo, CA 94404. (415) 571-1717. *Circle 73.*

Design to Print desktop publisher. This software lets home computer users make posters, flyers, certificates, greeting cards, banners, and newsletters. For IBM PC and compatible computers with 512 kilobytes of memory. \$49.95. Britannica Software, 345 Fourth St., San Francisco, CA 94107. (415) 546-1866. *Circle 74.*

Go computer game. A 4,000-year-old game of strategy from China; more complex than chess. Runs on Macintosh computers. \$39.95. Infinity Software Inc., 1144 65th St., Studio C, Emeryville, CA 94608. (415) 420-1551. *Circle 75.*

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Fax (902) 426-2054

Nova Scotia



Canada

MARKETWATCH

NEW COMPANIES

COMPANY	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Biatope 4 Nickerson St. Seattle, WA 98108 (206) 281-9600	To make a compact medical test for use in doctors' offices.	\$4 million from first-round financing	Jahn King, president William Horgreaves, chairman	Imre, president, COO Oncogen, senior researcher
Blyth Software 1065 E. Hillsdale Blvd. Foster City, CA 94404 (415) 571-0222	To provide relational-database software for IBM and Macintosh computers.	\$8 million from initial public offering (BLYH / NASDAQ)	Michael Kenny, president	Euro-Pacific PTY Ltd., director
Chartwell Cable Fund 7670 S. Vaughn Court Englewood, CO 80112 (303) 799-8909	To acquire and develop operating cable-television systems.	\$1 million from initial public offering	A. Clinton Ober, president, chairman Bryan McDaugal, v.p., director	Telecrofter, president, chairman Business and corporate lawyer
DisplayTek 1355 Holmes Rd. Elgin, IL 60123 (312) 931-2100	To supply cathode-ray-tube displays to original-equipment manufacturers.	Leveraged buyout	William Stafford, president Thomas Corcoran, chairman	Motorola, v.p. display div. Corcoran Partners, managing partner (current)
GA International Services 10955 John Jay Hopkins Dr. San Diego, CA 92121 (619) 455-3000	To provide technical advice and services to fossil-fuel and nuclear power plants throughout the world.	Undisclosed funding from parent company, GA Technologies	John Longenecker, president John Cleveland, exec. v.p.	U.S. Dept. of Energy, manager American Electric Power Co., director
InterCap 2525 Riva Rd. Annapolis, MD 21401 (301) 224-2926	To market a computer system that lets artists create and modify technical and artistic illustrations.	Undisclosed funding from Janney-Mant. Scott and InterCad	Thomas O. Mills, president Al Turnauer, v.p. sales/marketing	Applicon, account executive Scontech, national sales manager
Isis Health Sciences 107 Flatrock Rd. Ridgefield, CT 06877 (203) 438-7194	To acquire United Laboratory Services, which provides medical-testing services, and to add advanced testing technology, including tests for AIDS.	Undisclosed funding from Paragon Capital	Eckart Vallmer, president	Paragon Capital, president (current)
Micro-Contrôle USA 6 Landmark Square Stamford, CT 06901 (203) 359-5619	To sell micropositioning and optical systems for the semiconductor industry.	Undisclosed funding from French parent company	Robert Hessler, president	Cameco Instruments, manager
NTT America 200 Park Ave. New York, NY 10110 (212) 867-1511	To promote technology transfers and the participation of its parent company, Nippon Telegraph & Telephone, in joint R&D programs with North American companies.	Undisclosed funding from parent company	Keiji Tachikawa, president Iwao Kidakoro, sr. v.p.	NTT, general manager NTT, deputy general manager
On Technology 1 Cambridge Center Cambridge, MA 02142 (617) 225-2545	To develop software for personal computers.	Undisclosed funding from chairman	Mitchell Kapar, chairman Peter Miller, president	Lotus Development, founder Lotus Development, director of advanced technology
Supercomputer Systems 1414 W. Hamilton Ave. Eau Claire, WI 54701 (715) 839-8484	To develop next-generation parallel-processing computers.	Undisclosed funding	Steve Chen, president	Cray, v.p.

■ MARKETWATCH ■

COMPANY	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Truevision 7351 Shadeland Station Indianapolis, IN 46256 (317) 841-0332	To design, manufacture, and sell color-graphics boards, imaging software, and a graphics adapter.	Employee buyout of AT&T's EPICenter	Carthleen Asch, dir. finance & operations Carl Colabria, dir. engineering Joseph Haaf, dir. sales & marketing	EPICenter, mgr. finance & operations EPICenter, mgr. R&D EPICenter, mgr. sales & mkt.
Uniplex Distribution 9400 N. Central Expressway Dallas, TX 75231 (214) 373-4971	To distribute and service Uniplex software for products not sold through manufacturers.	Undisclosed funding from parent company, Redwood	Janice Bacon, coordinator	U.S. Dato, distribution manager
VCnet 2165 E. Francisco Blvd. San Rafael, CA 94901 (415) 485-0800	To serve as a value-added reseller, customizing and selling computer software and hardware.	Undisclosed funding from parent company, Software Resource	Dov Schriberg, president Leroy Trevers, v.p.	Software Resource, v.p. Private consultant

CONTRACTS AWARDED

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Advanced Decision Systems 201 San Antonio Circle Mountain View, CA 94040 (415) 941-3388	Science Applications International	Not disclosed	To develop an artificial-intelligence system for monitoring the seismic and geologic results of nuclear tests.
Apollo Computer 330 Billerica Rd. Chelmsford, MA 01824 (617) 256-6600	Docugraphix	\$3 million	To supply Apollo Series 3000 workstations as the platform for Docugraphix's Automated Documentation and Management System.
Apollo Computer 330 Billerica Rd. Chelmsford, MA 01824 (617) 256-6600	Siemens AG	\$100 million	To resell Apollo-based systems for such applications as computer-aided software development, documentation, and electronic design.
Boll, Aerospace Systems Div. Box 1062 Boulder, CO 80306 (303) 939-6183	U.S. Air Force	\$14 million	To provide a television subsystem that works at all light levels for AC-130U aircraft.
Boll, Efratom Division 3 Parker Irvine, CA 92718 (714) 770-5000	U.S. Air Force, Aerospace Guidance and Metrology Center	\$1.2 million	To supply rubidium frequency standards for the portable automatic-test-equipment calibrator program.
Ballantine Laboratories Box 97 Boonton, NJ 07005 (201) 335-0900	U.S. Air Force Station, Newark, Ohio	\$1.92 million	To supply AC/DC thermal-transfer calibration instruments.
Bornes & Reinecke 2375 Estes Ave. Elk Grove Village, IL 60007 (312) 640-7200	U.S. Army Armament, Munitions, and Chemical Command	\$11.4 million, with options to \$40 million	To provide nuclear, chemical, and biological-agent protection for the crews of M109 self-propelled howitzers.
Boeing Military Airplane Box 3707, M.S. 4H-14 Seattle, WA 98124 (206) 655-1198	General Dynamics	\$3.2 million	To design an integrated flight-control/avionics system for future tactical aircraft.
CanTel ASC 1801 Research Blvd. Rockville, MD 20850 (301) 251-8333	Defense Commercial Communications Office	\$2.1 million	To provide T1 satellite services for the Military Airlift Command's secure voice command and control system.
CanTel Federal Systems 12015 Lee Jackson Hwy. Fairfax, VA 22033 (703) 359-7500	U.S. Department of Energy, Idaho National Engineering Laboratory	\$24 million	To provide, on a lease-to-own basis, a private branch exchange (PBX) digital communications system (replacing a Centrex system).

■ MARKETWATCH ■

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Eaton 5340 Alla Rd. Los Angeles, CA 90066 (213) 822-3061	General Electric, Automated Systems Department	\$17 million	To develop the radio-frequency and microwave drawer subsystem for GE's Consolidated Automated Support System.
Epitope 15425 S.W. Kall Pkwy. Beaverton, OR 97006 (503) 641-6115	Orgonon Teknika	\$6 million	To manufacture, market, and distribute a Western blot AIDS-test kit.
Ericsson 100 Park Ave. New York, NY 10017 (212) 685-4030	EfiPos UK Ltd.	\$1.8 million	To provide at least 500 terminals for British banks to form a computerized national payment system.
Ericsson 100 Park Ave. New York, NY 10017 (212) 685-4030	Saudi Arabia PTT	\$41.3 million	To supply and install a long-distance fiber-optic telecommunications network in Saudi Arabia.
Hughes Aircraft Box 3310 Fullerton, CA 92634 (714) 732-3232	U.S. Army	\$18.9 million	To produce electronics for a radio-controlled mine.
Lockheed Aeronautical Systems Box 551 Burbank, CA 91520 (818) 955-7916	U.S. Air Force	\$2 million	To design and manufacture a generic structure for the Advanced Tactical Fighter, using advanced thermoplastic materials.
Lockheed Missiles & Space Box 35054 Sunnyvale, CA 94088 (408) 742-6688	U.S. Air Force, Space Division	\$1 million	To study ways to warn spacecraft of potential attacks.
LTV, Aircraft Products Group Box 655003 Dallas, TX 75265 (214) 266-2543	U.S. Air Force	\$133.6 million	To produce two A-7 Plus prototype aircraft.
MacAulay-Brown 3915 Germany Lane Dayton, OH 45431 (513) 426-3421	U.S. Air Force, Wright-Patterson Base	\$16 million	To continue support and research relating to pilot-centered cockpit interfaces.
Planning Research 1500 Planning Research Dr. McLean, VA 22102 (703) 556-2749	City of Stockton, California	\$600,000	To provide a police-dispatching system and a records-management system.
Planning Research 1500 Planning Research Dr. McLean, VA 22102 (703) 556-2749	City of Vancouver, British Columbia	\$2.7 million	To design and install a police-dispatching system and a mobile data-terminal system.
Planning Research 1500 Planning Research Dr. McLean, VA 22102 (703) 556-2749	General Electric Canada	\$7.6 million	To provide a police-dispatching system and a mobile data-terminal system.
Pratt & Whitney Box 109600 West Palm Beach, FL 33410 (305) 840-2439	U.S. Air Force	\$1.9 million	To evaluate the performance potential of an altitude-compensating nozzle for rocket engines.
Rockwell, Collins Defense 350 Collins Rd., N.E. Cedar Rapids, IA 52498 (319) 395-8504	U.S. Air Force	\$22.9 million	To supply the ARC-190 radio and installation kits.

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Rockwell, Collins Defense 350 Collins Rd., N.E. Cedar Rapids, IA 52498 (319) 395-8504	U.S. Navy	\$24.1 million	To supply the AN/ARC-182 UHF/VHF radio system.
Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78284 (512) 684-5111	U.S. Nuclear Regulatory Commission	\$3 million	To provide technical assistance regarding nuclear reactors and other matters concerning the nuclear-power industry.
Tolerant Systems 81 E. Doggett Dr. San Jose, CA 95134 (408) 433-5588	Control Data	\$3-million subcontract	To supply 18 fault-tolerant, Unix-based computer systems in a communications network at Wright-Patterson Air Force Base in Ohio.

MERGERS

COMPANY	BUSINESS	COMPANY	BUSINESS	NEW NAME
Financial Protection Services 6860 Commercial Dr. Springfield, VA 22150 (703) 658-6200	Consumer financial and data-registration services	CCC Information Services 640 N. LaSalle St. Chicago, IL 60610 (312) 787-2640	Computerized data services and claims management for automobile insurance companies	CCC becomes a wholly owned subsidiary of Financial Protection but retains its name
Sun Environmental 1700 Gateway Blvd. S.E. Canton, OH 44707 (216) 452-0837	Hazardous-waste (PCB) management and reclamation	Resource Engineering 3000 Richmond, Suite 400 Houston, TX 77098 (713) 520-9900	Environmental engineering and hazardous-waste management	Sun becomes a wholly owned subsidiary of Resource Engineering but retains its name

ACQUISITIONS

BUYER	BUSINESS	COMPANY ACQUIRED	BUSINESS	AMOUNT
Adage 1 Fortune Dr. Billerica, MA 01821 (617) 667-7070	IBM-compatible graphics workstations and terminals	CGX 1 Fortune Dr. Billerica, MA 01821 (617) 667-7070	IBM-compatible CAO/CAM graphics systems	Not disclosed
Bishop Graphics 5388 Sterling Center Dr. Westlake Village, CA 91359 (818) 991-2600	Computer-aided design and engineering systems	InterCad 3175 Velacruz Blvd. Santa Clara, CA 95054 (408) 727-2929	Computer-aided design workstations	\$275,000
Dischronics 34 Queen St., Melbourne, Victoria 3000, Australia 011-61-3-622775	Compact-disc manufacturing	Loservideo 1 E. Wacker Dr. Chicago, IL 60601 (312) 467-9006	Compact-disc manufacturing	\$55.5 million
Genex 16020 Industrial Dr. Goithersburg, MD 20877 (301) 258-0552	Specialized proteins and protein products	Xydex 4 Alfred Circle Bedford, MA 01730 (617) 275-2000	Sample-preparation devices	Not disclosed
Great Lakes Terminal 1750 N. Kingsbury St. Chicago, IL 60614 (312) 664-3500	Distribution of fiberglass, plastics, and chemicals	Rimcraft Technologies 1914 English Rd. High Point, NC 27260 (919) 841-7995	Distribution of processing equipment for fiberglass-reinforced plastic	Not disclosed
Multitech 1012 Stewart Dr. Sunnyvale, CA 94086 (408) 773-8400	IBM-compatible microcomputers	Counterpoint Computers 2127 Ringwood Ave. San Jose, CA 95131 (408) 434-0190	Multi-user, Unix-based microcomputers	Not disclosed

BUYER	BUSINESS	COMPANY ACQUIRED	BUSINESS	AMOUNT
NCR 1700 S. Patterson Blvd. Dayton, OH 45479 (513) 445-5D00	Business-information computer systems	Datagraphix Box 82449 San Diego, CA 92138 (619) 291-9965	Nonimpact printers	Not disclosed
S.A.Y. Technology Group 4 Station Square Pittsburgh, PA 15219 (412) 281-5959	Integration and design of corporate electronic- publishing systems	Tyrega Technology 10740 Lyndall Ave. S. Bloomington, IL 55420 (612) 888-3855	Development of systems that design business forms	Not disclosed
Sony 9 West 57th St. New York, NY 10019 (212) 371-5800	Electronics manufacturing	CBS Records 51 West 52nd St. New York, NY 10019 (212) 975-4321	Music recordings	\$2 billion
Teradyne 321 Harrison Ave. Boston, MA 02118 (617) 482-2700	Automatic test equipment and software	Aido 5155 Old Ironside Dr. Santa Clara, CA 95054 (408) 748-8571	Computer-aided-engineering software	\$33 million
Terra-Mar Resource Info. 1937 Landings Dr. Mountain View, CA 94043 (415) 964-6900	Mapping software, systems integration	Geasim 19 Briar Hollow Lane Houston, TX 77027 (713) 623-B070	Geological software	Not disclosed
Unisys Box 418 Detroit, MI 48232 (313) 972-7000	Computers and related equipment	Timeplex 400 Chestnut Ridge Rd. Woodcliff Lake, NJ 07675 (201) 391-1111	Data-communications equipment	\$33D million

JOINT VENTURES

COMPANY	COMPANY	PURPOSE	CONTACT
Alde Publishing	Context Translations	To publish an English translation of the last two years of <i>Pravda</i> , the daily newspaper of the Soviet Union's Communist Party, on CD-ROM compact discs.	Alde Publishing 7840 Computer Ave. Minneapolis, MN 55435 (612) 835-5240
Allelix	Mitsui Petrochemical Industries	To research and commercialize two anticancer drugs, vincristine and vinblastine.	Allelix 6850 Goreway Dr. Mississauga, Ont. L4V 1P1 (416) 677-0831
AT&T	Telerote	To offer a foreign-exchange transaction service to compete with the service offered by Reuters Holdings PLC.	AT&T 100 Southgate Parkway Morristown, NJ 07960 (201) 898-8000
Daman Clinical Laboratories	Community Psychiatric Centers	To open a clinical laboratory in the Atlanta area to provide medical treatment in the Southeast.	Damon Clinical Laboratories 115 Fourth Ave. Needham Hts., MA 02194 (617) 449-0800
ICF	Global Trade & Investment	To consult on international trade and financial issues, provide assistance in negotiating abroad, and create trade-related databases.	ICF 9300 Lee Highway Fairfax, VA 22031 (703) 934-3004
Infodata Systems	Northwestern National Life Insurance	To develop software for life-insurance underwriters, called SURE (Systems for Underwriting Risk Evaluation), which Northwestern National Life will upgrade quarterly.	Infodata Systems 5205 Leesburg Pike Falls Church, VA 22041 (703) 578-3430

RESEARCH REPORTS

STUDY BY	TITLE	FORECAST	PRICE
Able Communications 515 Kevenaire Dr. Milpitas, CA 95035 (408) 945-1484	T1 Multiplexers (# T21)	The \$250-million 1987 market for large and small T1 multiplexers will increase to \$350 million this year (\$250 million for large units and \$100 million for small units).	\$1,250
Able Communications 515 Kevenaire Dr. Milpitas, CA 95035 (408) 945-1484	T1 Channel Service Units (# T20)	Market growth, which totaled \$25 million in 1987, will increase to \$60 million by 1990, but the average price will drop 13 to 15 percent annually.	\$1,600
Able Communications 515 Kevenaire Dr. Milpitas, CA 95035 (408) 945-1484	Switched-56 Equipment and Services (# S19)	The market increase of \$2.4 million in 1987 will rise to \$12.5 million in 1990.	\$1,250
Business Communications 25 Van Zant St. Norwalk, CT 06855 (203) 853-4266	Opportunities for Plastics in Static-Control Applications	1987's \$147-million market for static-control plastics will reach \$264 million by 1992, growing about 12 percent each year.	\$2,250
Find/SVP 625 Ave. of the Americas New York, NY 10011 (212) 645-4500	High-Technology Industrial Ceramics	U.S. market in aerospace, electronic, medical and other applications will exceed \$12.5 billion by 2005; if ceramics move into engines and solar energy, market could reach \$23.1 billion.	\$1,450
Kline & Company 330 Passaic Ave. Fairfield, NJ 07006 (201) 227-0882	High-Performance Films	Analyzes emerging film technologies that will outperform present films, creating significant market opportunities.	\$5,000
Kline & Company 330 Passaic Ave. Fairfield, NJ 07006 (201) 227-0882	High-Performance Battles	Analyzes the impact of new battle-making technologies and barrier structures on beverage, food, and chemical packaging.	\$5,000
Kline & Company 330 Passaic Ave. Fairfield, NJ 07006 (201) 227-0882	Irradiation-Resistant Packaging	Analyzes the opportunities for packaging suppliers created by the increased use of irradiation for food preservation and medical sterilization.	\$5,000
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	Intelligent Material Handling Markets	The market for self-guided vehicles, automatic storage/retrieval systems, and programmable monorail carriers will grow 5 to 10 percent yearly, reaching \$1.7 billion by 1993.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	U.S. Field-Service Test-Equipment Markets	By 1993, the market will reach \$2.46 billion, growing 14 percent annually.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	World Medical-Electronics Markets II (# A238)	The total market will grow from less than \$9 billion in 1986 to nearly \$14 billion in 1992.	\$995
Venture Development Box 9000 Natick, MA 01760 (617) 653-9000	The Market for Switches in the Electronics Industry: A Strategic Analysis	The market will exceed \$1.5 billion by 1991.	\$3,250
Yankee Group 200 Portland St. Boston, MA 02114 (617) 367-1000	Voice-Processing Alternatives: Speech Recognition	Annual market growth will be 20 to 30 percent through 1989.	\$1,500

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Picture Phone, Tire Minder

OFFICE

Phone for show and tell

AFTER YEARS as a technological fantasy, picture phones are finally here. Mitsubishi's VisiTel lets callers send freeze-frame black-and-white images to other VisiTel phones. It connects to a standard telephone, which may be used separately to make regular calls.

To send a picture, a person sits in front of the machine's built-in video camera and presses a button. In about five seconds, the person's image appears on the 4½-inch monitor of the receiving VisiTel. The more timid may use VisiTel to send other pictures stored in memory. The camera also can be focused on an object, such as a design drawing.

Mitsubishi's Visual Telecom Division in Santa Clara, Calif., is angling to be the leader in the viewer-phone field. The division expects to sell 150,000 of the \$399 units this year, but it may soon have competition. Sony, teamed with Nippon Telegraph & Telephone, offers a comparable monitor in Japan, but has no immediate plans to sell the device in the United States. NEC is working on videophones and recently exhibited some models. Panasonic, part of Matsushita Electric, is also considering similar products.

To find the location of the nearest VisiTel dealer, call (800) 422-5862.



Tire-pressure controller helps drivers keep the jack in the trunk.

AUTO

Tires get pressured

THERE WAS a time when the guy who pumped your gas and washed the windshield would also check your tires. Though it's less personal, the EntireControl system is technology's alternative; it automatically adjusts tire pressure.

The system, made by TechniGuidance, uses a computer to monitor sensors in each tire. When pressure changes, the computer sends a signal to activate a switch on the appropriate wheel. The switch either deflates the tire or adds air from a compressed-air cartridge.

A dashboard display warns the driver of slow leaks and allows manual adjustment, and drivers also can program the system to adjust pressure for highway or city driving. For instance, firmer tires result in better gas mileage on the highway; softer tires provide a more comfortable ride around town.

EntireControl is currently being test marketed in Cali-



fornia. The \$400 system must be installed by a factory-trained mechanic and is available for a limited number of models: the Thunderbird Turbo Coupe, Cadillac DeVille, Buick Electra, Oldsmobile 98, and four-wheel-drive Jeeps. TechniGuidance expects to add about 15 more models by the end of the year and is negotiating with automakers to install the system on luxury and high-performance cars.

"Consumers will give automakers the message that they want this product," says Harish Chinai, TechniGuidance's vice president of sales and marketing.

The company—which has not yet found a replacement for the gas-station windshield washer—is located at 3000 Coronado Dr., Santa Clara, CA 95054. Phone (408) 970-8841.

HOME

Studio touches for home videos

THE GROWING number of home-movie enthusiasts who have switched from film to video can now add studio-like embellishments to their tapes.

The DirectED home-editing system made by Videonics serves as editor, library, titler, and special-effects generator. The \$499 editor works with all tape formats and requires a remote-control VCR, a camcorder (or second VCR), and a television set.

To edit, you isolate taped sequences, name them, and list the sequences in the desired order. By selecting from menus, you can create titles, special effects, and graphics.

Collected, a library of additional video graphics, will be available later this year for \$79.95. Videonics is located at 1129 Dell Ave., Campbell, CA 95008. Telephone (408) 866-8300.



VCR editor turns a home into a production studio.

BILL O'CONNELL

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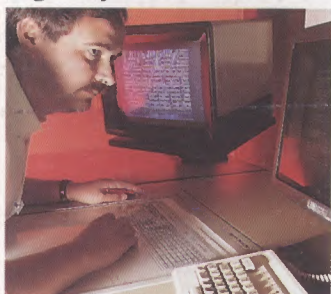
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